THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1717.] LONDON, APRIL 7, 1896. [48TH YEAR. PRICE 6d.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

Lanemark Coal Co.,
LIMITED.

LANEMARK CANNEL AND GAS COALS.

Quotations and Analysis on Application to

LANEMARK COLLIERY,
NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

— ESTABLISHED 1830. —
PARKER & LESTER,
Manufacturers & Contractors.

THE ONLY MAKERS OF
PATENT ANTIMONY PAINT,
Parker's Imperial Black Varnish,
Oxide Paints, Oils, and General Stores for Gas and Water Works.

WORKS:
ORMSIDE STREET, OLD KENT ROAD,
LONDON.

"BEAR CREEK" CANNEL.
LOG MOUNTAIN COAL, COKE, AND TIMBER CO.
PINEVILLE, KENTUCKY, U.S.A.
Cable Address: "Hull, Pineville."

LONDON AGENTS:
W. J. WILSON & CO., Suffolk House, Cannon St., E.C.

NORTON'S PATENT
"ABYSSINIAN" & ARTESIAN TUBE WELLS,
FOR TOWN WATER-WORKS AND OTHER SUPPLIES.

The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.

LE GRAND & SUTCLIFF,
HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

THE MELDRUM FURNACE FOR DUST-FUEL.

3333

FITTED
to January 1, 1896.

SPECIALLY USEFUL FOR GAS-WORKS.

MELDRUM BROS.,
ATLANTIC WORKS, MANCHESTER;
16, UNION COURT, LONDON;
5, EAST PARADE, LEEDS;
58, COLLINGWOOD STREET,
NEWCASTLE-ON-TYNE.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

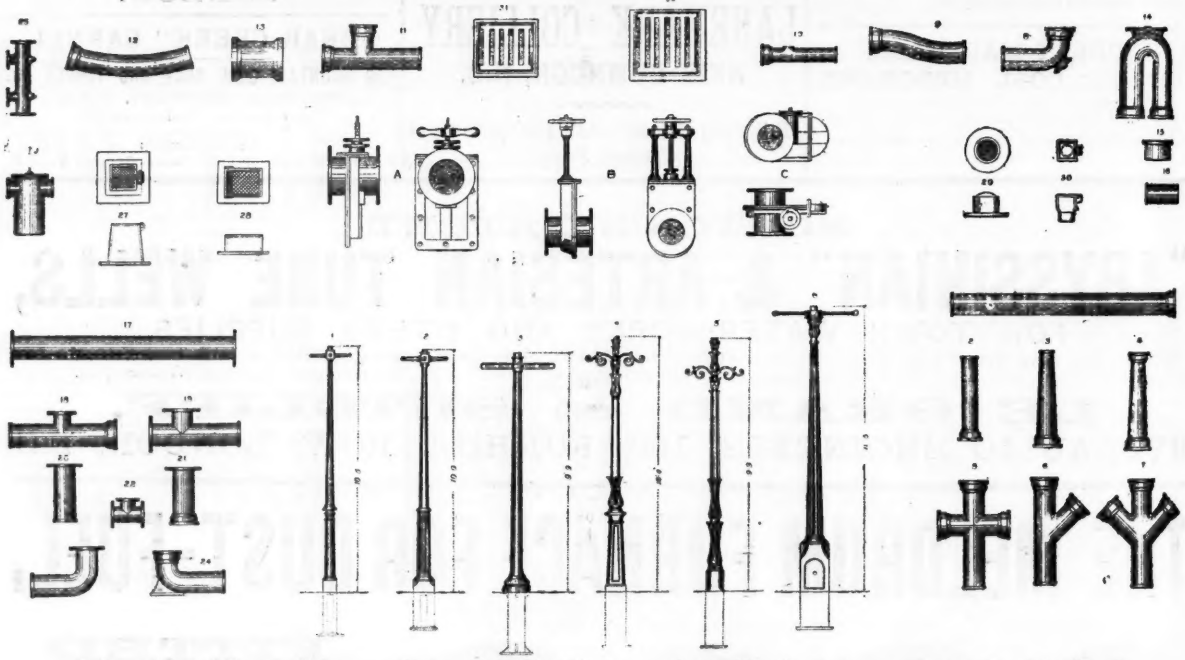
Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

EDWARD COCKEY & SONS, Ltd.,

GAS ENGINEERS, CONTRACTORS, IRON & BRASS FOUNDERS, &c.,

FROME, SOMERSET.



A Quantity of Lamp Columns, Valves, and Castings, as above Illustrated, are always kept in Stock ready for immediate delivery.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—

MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

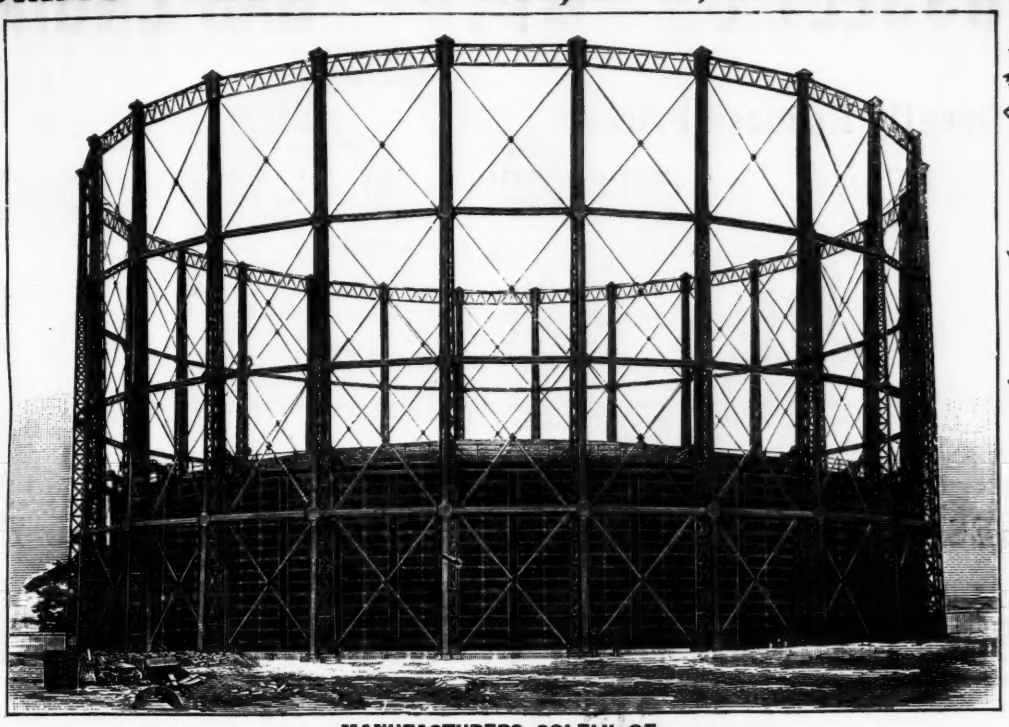
SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

LONDON:	MANCHESTER:	BIRMINGHAM:	LEEDS:
168, Southwark Street.	33, King Street West.	114, Colmore Row.	6, Mark Lane, New Briggate.

THOMAS PIGGOTT & CO., LTD., BIRMINGHAM.

LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT. FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS BIRMINGHAM

WELDED & RIVETED PIPES, FOUL MAINS, RETORT. LIDS, WROT & CAST TANKS, PURIFIERS.

MANUFACTURERS SOLELY OF

HUMPHREYS & GLASGOW'S PATENT CARBURETTED WATER-GAS PLANT.

— HAS ALREADY BEEN SUPPLIED TO GAS-WORKS AT —

COPENHAGEN, BRUSSELS, GLASGOW, BELFAST, LIVERPOOL, TOTTENHAM, and is in course of Erection now at BELFAST (Second Contract), SWANSEA, BRIGHTON, PRESTON, SOUTHPORT, MANCHESTER, and BATH.

Inquiries to be sent to the Patentees: 9, VICTORIA STREET, LONDON, S.W.

GAS COAL.

BEST

REAL OLD SILKSTONE GAS COAL,

Address THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

NEWTON, CHAMBERS, & CO., LIMITED

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

MANUFACTURERS OF

SLIDE VALVES, WITH RACK & PINION OR Internal or External SCREWS of all sizes.

GASHOLDERS, AND Gasholder Tanks.

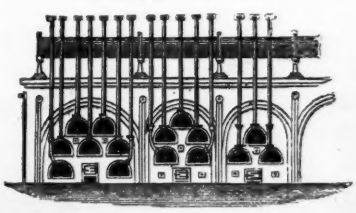
CAST-IRON RETORTS,

RETORT-BED FITTINGS,

And Retort-House Appliances

of every description,

Iron Roofs, Columns, Girders, Floor Plates, Tools, &c.



WROUGHT AND CAST IRON

CONDENSERS, SCRUBBERS, & WASHERS,

TAR AND LIQUOR PUMPS, &c.

PATENT

CENTRE-VALVES

for working Purifiers,

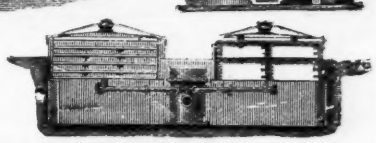
Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,

HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS, and SPECIALS.

WOOD GRIDS.

CAST AND WROUGHT IRON TANKS AND CISTERNS.



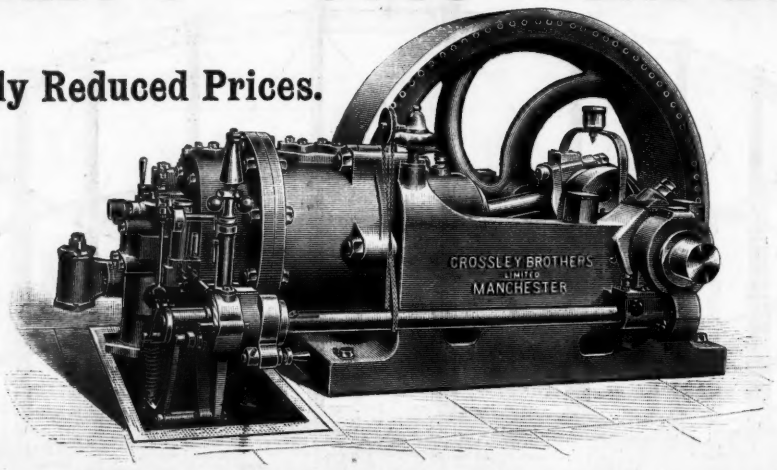
DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

CROSSLEY'S "OTTO" GAS-ENGINES

Greatly Reduced Prices.



REPRESENTS NEW TYPE 40-HORSE POWER NOMINAL HIGH-SPEED ELECTRIC-LIGHT ENGINE.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.

HARRIS & PEARSON,

STOURBRIDGE, ENGLAND,

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

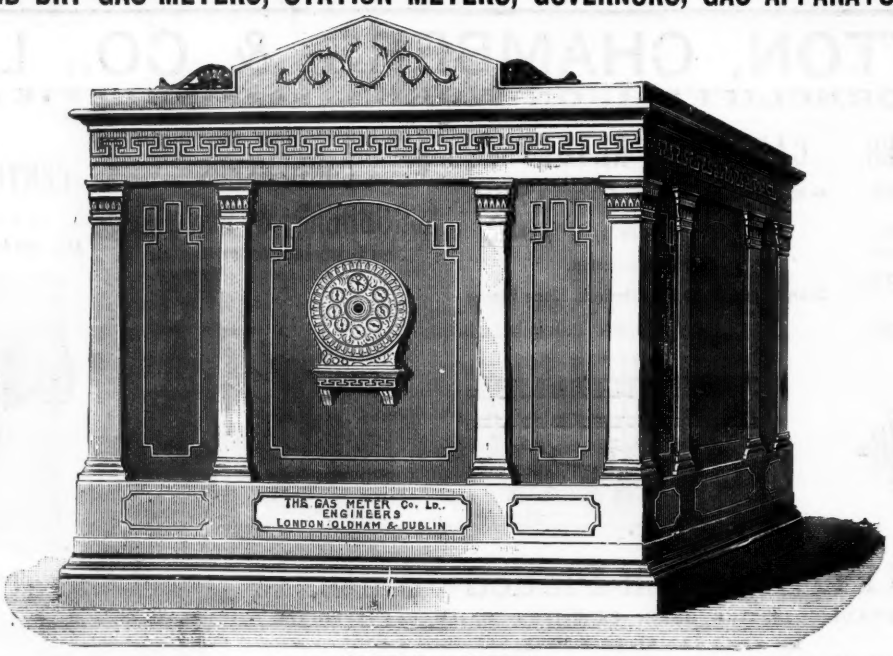
GLAZED BRICKS AND PORCELAIN BATHS.

THE GAS-METER COMPANY, LIMITED

MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.



STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, LATE WEST & GREGSON. Established 1830.

For Prices and Particulars apply to

R. L. ANDREWS, General Manager.

Works: 238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

[See Advertisement on back of Wrapper.

INCANDESCENT GAS-LIGHT

(Welsbach Patents).

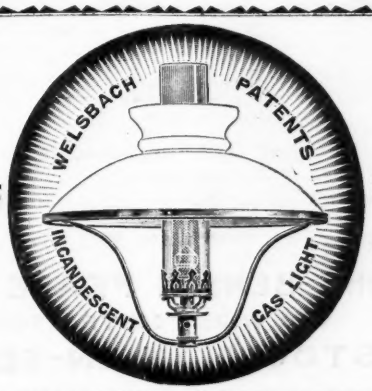
Further Great Reduction in Prices,

FROM MARCH 2, 1896,

Due to Colossal Sales,

Places this highly popular Light within the means of all classes.

The greatly Reduced Consumption of Gas COVERS THE INITIAL COST OF THE BURNERS IN FROM SIX TO EIGHT MONTHS.



The PRICES have been REDUCED as follows:—

The Ordinary "C" Burner to 6s. 6d.

The "C" Bye-Pass Burner to 7s. 6d.

Prices of other Patterns reduced proportionately.

SPECIAL ATTENTION IS CALLED TO THE

"S" BYE-PASS BURNER, PRICE 7s. 6d.

Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

The attention of Gas Managers and Gas Engineers is called to this System of Lighting as one which tends to Popularize the use of Gas as an Illuminant, owing to the following Advantages—

ECONOMY IN CONSUMPTION OF GAS, COMBINED WITH HIGH ILLUMINATING EFFICIENCY.

FREEDOM FROM SMOKE, DIRT, AND FLICKERING.

GREATLY REDUCED HEAT.

The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

SUITABLE FOR EVERY PURPOSE OF INSIDE OR OUTSIDE LIGHTING.

For further Particulars, apply to

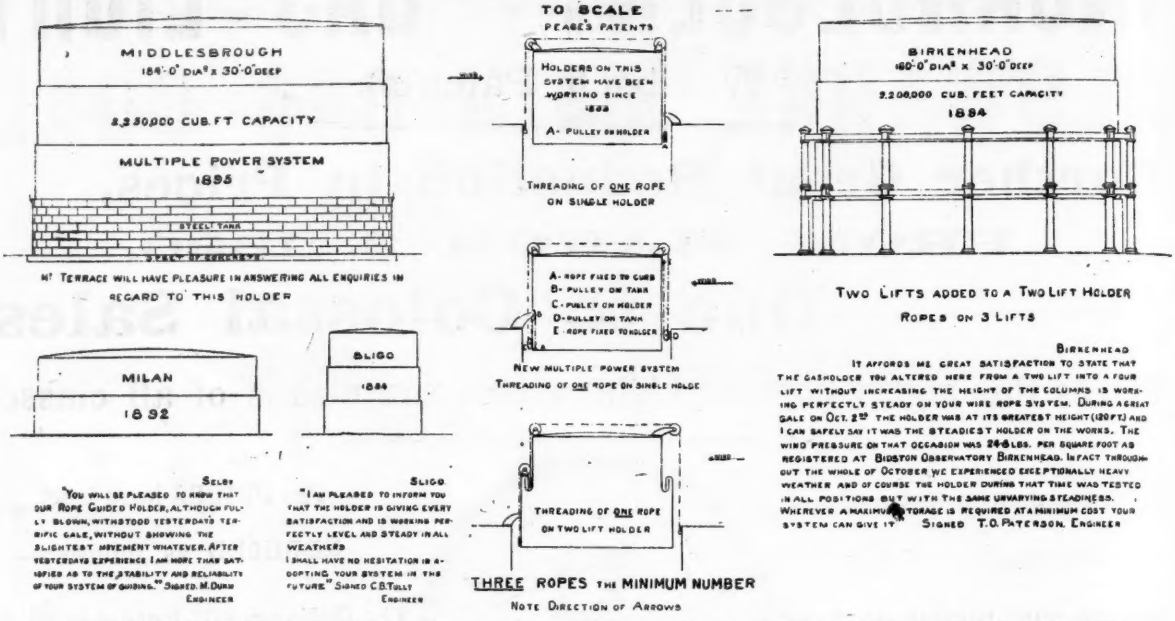
The INCANDESCENT GAS-LIGHT CO., LIMITED,

Palmer Street, Westminster, London, S.W.

DIAGRAMS ILLUSTRATING REPRESENTATIVE ROPE GASHOLDERS

TO SCALE

PEASE'S PATENTS



Mr TERRACE WILL HAVE PLEASURE IN ANSWERING ALL ENQUIRIES IN REGARD TO THIS HOLDER

TWO LIFTS ADDED TO A TWO LIFT HOLDER

ROPES ON 3 LIFTS

SELBY

"YOU WILL BE PLEASED TO KNOW THAT OUR ROPE GUIDED HOLDER, ALTHOUGH FULLY BLOWN, WITHSTOOD YESTERDAYS TERRIFIC GALE, WITHOUT SHOWING THE SLIGHTEST MOVEMENT WHATEVER. AFTER YESTERDAYS EXPERIENCE I AM MORE THAN SATISFIED AS TO THE STABILITY AND RELIABILITY OF YOUR SYSTEM OF GUIDING." SIGNED M. DUNN ENGINEER

SLIGO

"I AM PLEASED TO INFORM YOU THAT THE HOLDER IS GIVING EVERY SATISFACTION AND IS WORKING PERFECTLY LEVEL AND STEADY IN ALL WEATHERS
I SHALL HAVE NO HESITATION IN ADOPTING YOUR SYSTEM IN THE FUTURE." SIGNED C.B. TULLY ENGINEER

BIRKENHEAD

IT AFFORDS ME GREAT SATISFACTION TO STATE THAT THE GASHOLDER YOU ALTERED HERE FROM A TWO LIFT INTO A FOUR LIFT WITHOUT INCREASING THE HEIGHT OF THE COLUMNS IS WORKING PERFECTLY STEADY ON YOUR WIRE ROPE SYSTEM. DURING A GREAT GALE ON OCT. 21ST THE HOLDER WAS AT ITS GREATEST HEIGHT (120 FT.) AND I CAN SAFELY SAY IT WAS THE STEADIEST HOLDER ON THE WORKS. THE WIND PRESSURE ON THAT OCCASION WAS 24 LBS. PER SQUARE FOOT AS REGISTERED AT BIDSTON OBSERVATORY BIRKENHEAD. IN FACT THROUGHOUT THE WHOLE OF OCTOBER WE EXPERIENCED EXCEPTIONALLY HEAVY WEATHER AND OF COURSE THE HOLDER DURING THAT TIME WAS TESTED IN ALL POSITIONS BUT WITH THE SAME UNVARYING STEADINESS. WHEREVER A MAXIMUM STORAGE IS REQUIRED AT A MINIMUM COST YOUR SYSTEM CAN GIVE IT." SIGNED T.O. PATERSON, ENGINEER

THESE HOLDERS ARE CONSPICUOUS FOR STEADY AND LEVEL WORKING UNDER ALL CONDITIONS. THEY WORK WITH MUCH LESS FRICTION AND IRREGULARITY IN A GALE OF WIND THAN GASHOLDERS WITH COLUMNS, AND ARE ALWAYS STEADY.

ASHMORE BENSON PEASE & Co. Ld.

GAS WORKS CONTRACTORS

STOCKTON-ON-TEES

LATEST

Improvements in Sulphate of Ammonia Apparatus

(COLSON'S PATENT)

EXTRACT FROM ENGINEER'S REPORT—

"I can now obtain 60 Tons of Sulphate of Ammonia per week with 'Colson's' Still, using ONE Boiler, whereas, with my former continuous plant, TWO Boilers were required to produce 40 Tons per week."

For Prices and Particulars, apply to the Sole Makers—

ASHMORE, BENSON, PEASE, & CO., LIMITED,

Gas-Works Contractors, STOCKTON-ON-TEES.

THE SILICA FIRE-BRICK COMPANY,

OUGHTYBRIDGE, NEAR SHEFFIELD.

Established 1858. The First Manufactory of Silica and Dinas Fire-Bricks erected in England.

MANUFACTURERS OF

SILICA FIRE-BRICKS

(TRADE MARK "SILICA")

Specially adapted for Siemens-Martin Gas-Furnaces; also for Gas, Copper, Iron, Steel, and other Furnaces where intense heat is required.

BESSEMER GANNISTER, STEEL-FURNACE GANNISTER, COPPER-FURNACE GANNISTER, IRONFOUNDERS' CUPOLA SAND, FINE-SETTING SILICA CEMENT, STEEL MOULDERS' COMPOSITION.

Our Silica Bricks have gained a high reputation for Unsurpassed Quality in most of the leading Firms in England and on the Continent. Export orders delivered Liverpool, Hull, Grimsby, or the Tyne.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

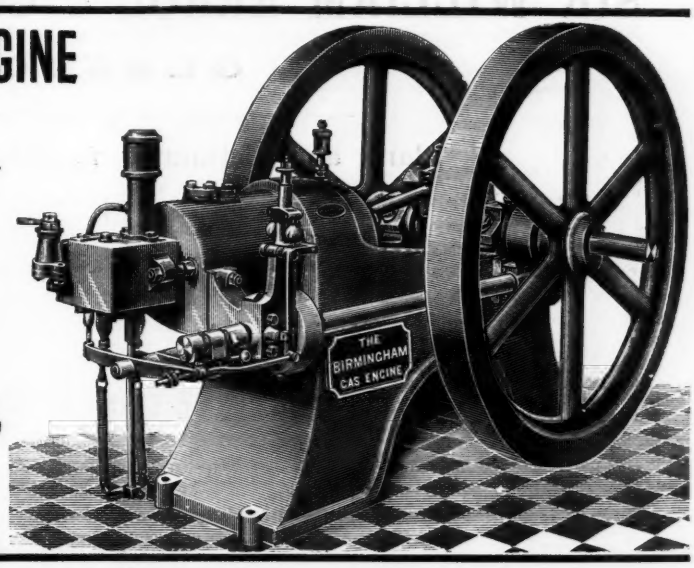
TELEGRAMS: "ATLAS, SHEFFIELD."

THE BIRMINGHAM GAS-ENGINE

"OTTO" CYCLE.

A thoroughly reliable Engine for Commercial or Electric Lighting Purposes. Simple, Strong, Interchangeable.

Adopted by the Corporation of Birmingham Gas Department for Driving the Conveyors at their Swan Village Works.



WILLIAM GRICE & SONS,

Engineers and Founders,

FAZELEY STREET, BIRMINGHAM.

LONDON REPRESENTATIVE: Mr. SAM PUPLETT, M.I.M.E., 47, Albany Buildings, Victoria Street, Westminster.

GASHOLDERS

OF ALL SIZES.

GADD & MASON'S

PATENT

COLUMNLESS SPIRAL-GUIDED GASHOLDERS.

SOLE MAKERS:

C. & W. WALKER,

MIDLAND IRON-WORKS, DONNINGTON, NEAR NEWPORT, SHROPSHIRE;

Telegraphic: "Fortress, Donnington, Salop." 10, FINSBURY SQUARE, LONDON. Telegraphic: "Fortress, London."

ARROL-FOULIS

PATENT AUTOMATIC MACHINERY

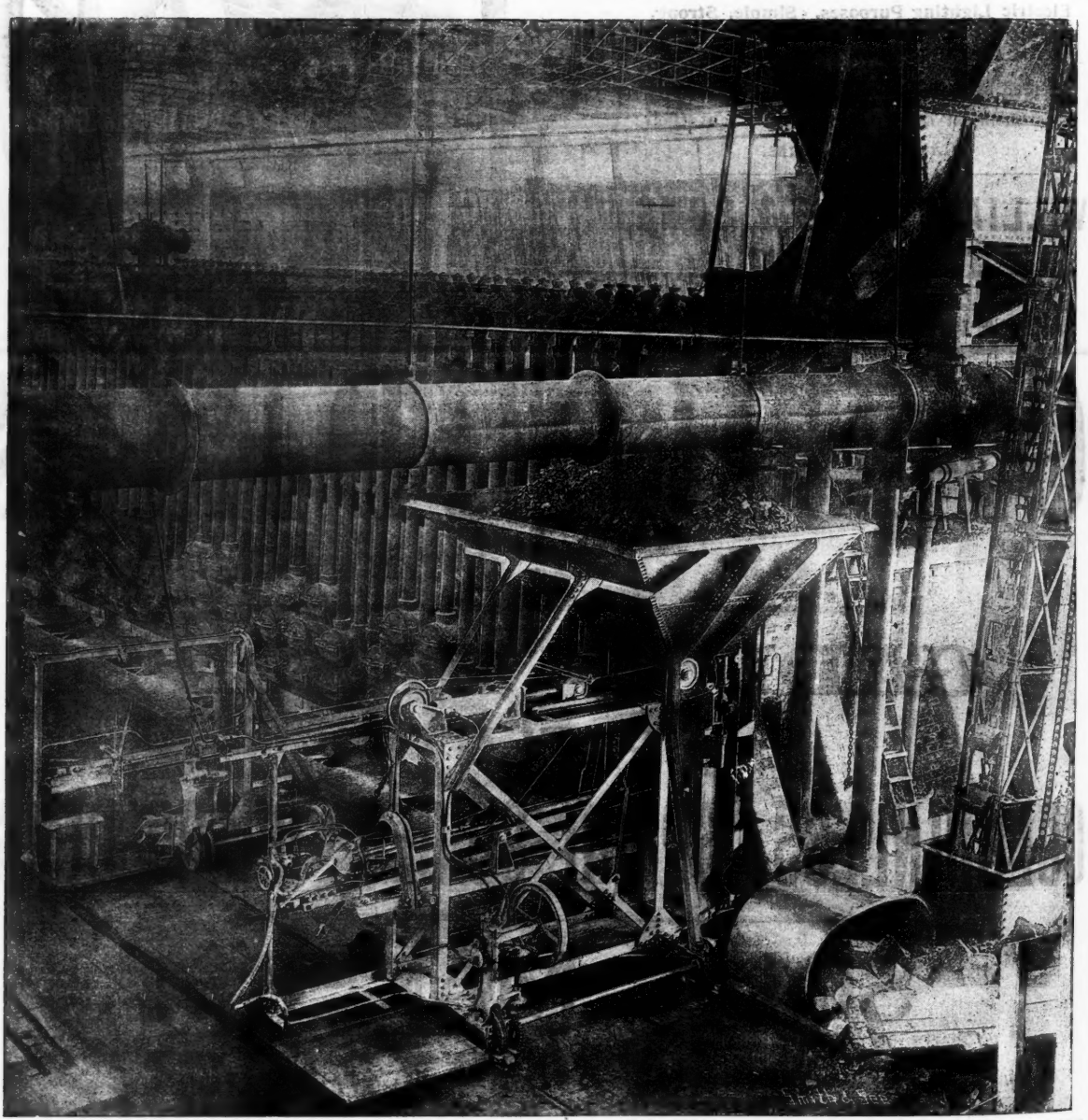
FOR

CHARGING AND DRAWING GAS-RETORTS

SIR WILLIAM ARROL & CO., Ltd., Sole Makers,

GLASGOW.

Plans and Estimates furnished on application.



The above engraving shows the interior of a Retort-House at the Tradeston Gas-Works, Glasgow, where the Machines have been at work since the beginning of 1893, drawing and charging **960 Retorts every 24 hours. 86 Drawing-Machines and 58 Charging-Machines are at work, or in course of construction.**

KIRKHAM, HULETT, & CHANDLER, LD.

3 & 4, Palace Chambers, Bridge Street, Westminster, S.W.

WASHER-SCRUBBERS — Over 500 Patent "Standard" Washer-Scrubbers now in use. These Machines extract all the Ammonia and a large proportion of CO_2 and H_2S.

CONDENSERS — Marshall's Patent Combined Battery Condenser and Scrubber, as supplied to the following Gas-Works: Coventry (3), Randers, Elsinore, and Aalborg, &c.

TAR-SEPARATORS — Burmeister and Wain's Tar-Separator. Extracts over 99 per cent. of the Ammoniacal Liquor from Tar, rendering the latter saleable at higher prices.

TAR-EXTRACTORS — Marshall's Patent Tar-Extractor. Extracts all the Tar without choking up.

WATER-SOFTENERS — Bruun's Patent Water-Softener. Prevents all "Scale" in Boilers, increases Life of same, and saves Fuel.

Prices, &c., on application to the above.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

650,000,000

CUBIC FEET OF GAS PER DAY.

Among the Companies supplied are The Gaslight and Coke Company, the South Metropolitan Gas Company, Birmingham Corporation, Manchester Corporation, Rochdale Corporation, Bristol Gas Company, and many other Works, both large and small, where they have been working in some instances for the past **FOUR YEARS.**

More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital, Labour, Fuel, Wear and Tear, &c.

The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

SOLE AGENTS FOR REDWOOD & CLOWES' INFLAMMABLE VAPOUR & GAS DETECTORS.

Dealers in Carburine and all other Naphthas for the Enrichment of Gas.

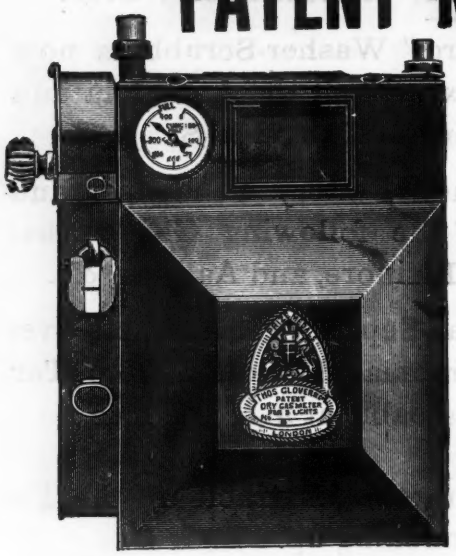
FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

THOMAS GLOVER & CO.'S

PATENT NEW IMPROVED PREPAYMENT METER



For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

Telegraphic Address: "GOTHIC LONDON." Telephone No. 6725.

THOMAS GLOVER & CO.,

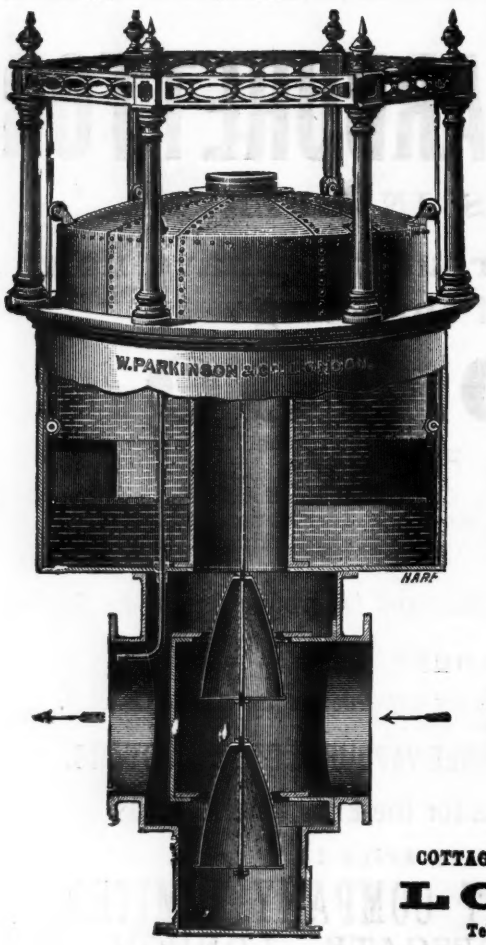
DRY GAS-METER MANUFACTURERS,

214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

BRISTOL: 62, VICTORIA STREET. *Telegraphic Address: "GOTHIC."*

BIRMINGHAM: 3, BRIDGE ROW, DERITEND. *Telegraphic Address: "GOTHIC."*

MANCHESTER: 37, BLACKFRIARS STREET. *Telegraphic Address: "GOTHIC."*



PARKINSON'S

PATENT

EQUILIBRIUM GOVERNORS.

A very large number are now at work; and all Engineers who have adopted them speak in unqualified terms of their great efficiency.

COUNTERBALANCE or AIR VESSEL, as desired.
TWO, FOUR, or SIX COLUMNS and GIRDERS.
WEIGHTS or WATER PRESSURE.

COTTAGE LANE WORKS, CITY ROAD, **LONDON.** Telegraphic Address: "INDEX."

BELL BARN ROAD WORKS, **BIRMINGHAM.** Telegraphic Address: "GAS-METERS."

[See also Advt. p. 764.

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE

The Affairs of the Commercial Gas Company 739
The Coin Meter in Court Again 740
End of the Hearing of the Incandescent Burner Lawsuits . . . 740
Rumoured Abandonment of Coin Meters by the Chartered Company 741

WATER AND SANITARY AFFAIRS—

The London County Council and the Water Question—The Lost Transfer Bills 741
The Meeting of the East London Water Company 741

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market 742
Electric Lighting Memoranda. 742
The Production and Use of Calcium Carbide 743
The Philosophy of Politics and Administration 743

NOTES:—

Sulphate of Ammonia and Hay Crops 744
The Waste of Steam-Boilers and Engines 744
Professor Witz on Cheap Engine Gas 745
The Durability of Paints 745
Gas-Ovens for Disinfecting Books 745

COMMUNICATED ARTICLE:—

Advances in Technical Gas Analysis. By G. E. Brown, A.I.C. . 745

TECHNICAL RECORD:—

The Acetylene Theory of Luminosity—Paper by Professor V. B. Lewes, F.I.C., F.C.S. 747
Winstanley's Ammonia Saturator and Sulphur Condenser . . . 749
Researches on the Combustion of Illuminating Gas in Cooled Flames and Gas-Motors. By Dr. F. Haber and A. Weber . . 749
The Recovery of Ammonia from Blast-Furnace Gases—Paper by Mr. A. Gillespie 750

REGISTER OF PATENTS:—

Preventing the Freezing of Water in Gasholder Cups and Tanks—Tritton, C. H. 752
Washing-Gas—Holmes, P. F. 753
Gas Motors—Donaldson, W. 753
Illuminant to be Used in Connection with Gas Lamps—Robertson, J. C., and Wallace, J. A. 753
Prepayment Gas-Meters—Sutherland, A. G., Stidder, J. G., Everett, J. F. 753
Exhaust Silencer and Circular Pump for Gas-Engines—Turner, E., and Harding, G. J. 754
Patent Notices 754

CORRESPONDENCE:—

Cripps's Patent Purifier-Valve 754
Charging for Unregistered Gas 754

PARLIAMENTARY INTELLIGENCE:—

House of Commons—Progress of Bills 755
House of Lords Committee—Cowes Gas Bill 755

LEGAL INTELLIGENCE:—

High Court of Justice—Queen's Bench Division—The Incandescent Gas-Light Company, Limited, *v.* The Sunlight Incandescent Gas-Lamp Company, Limited 757
West Ham Police Court—The Supply of Gas by Automatic Prepayment Meters 761

MISCELLANEOUS:—

Meeting of the Commercial Gas Company 762
Meeting of the Alliance and Dublin Consumers' Gas Company . 763
Meeting of the East London Water-Works Company 763
Meeting of the Bristol Water-Works Company 765
A Continental Municipality and Gas and Water 765
Leeds Gas Committee and their Workmen—The Men Canvassed. 765
The Bolton Corporation and the Sale of Gas Residuals—An Alleged "Ring" of Tar Buyers 765
Penrith Gas Supply—A Highly Satisfactory Year's Work . . . 765
The Fatal Explosion at the Cheltenham Gas-Works 766
Electric Lighting Notes 766
The London County Council and the Water Question 767
The Thames Conservators and the Purity of the River—The Water Companies' Money Contributions 768
Notes from Scotland. 768
Current Sales of Gas Products 769
Coal Trade Reports. 769
Gas and Water Companies' Stock and Share List 770

PARAGRAPHS:—

PERSONAL: Mr. A. C. Pain, M.Inst.C.E.; Mr. Hartwell Conder; M. Berthelot; Mr. W. H. Collins 744
Eastern Counties Gas Managers' Association 741
Russian Petroleum 744
"Recent Chemical Progress"—The Gas Referees' Summer Instructions—The Annual Meeting of Scottish Gas Managers—Institution of Civil Engineers—A New Carbide of Zirconium—Petroleum for Lighting Beacons and Buoys—Corrugated Water Pipes—The Coal Production of Belgium and Germany 746
Society of Engineers 749
Incandescent Gas Lighting—Registration of Water-Meters . . 752
Increased Coal-Storage for the Leeds Gas-Works—Cleveland Gas Company—The Mourne Scheme of the Belfast Water Commissioners—Sales of Shares 754
Monte Video Water-Works Company, Limited 757
Bolton Corporation Water-Works—Waste of Water at Batley—Gas Affairs at Dorking 761
Cape Town and District Gas Company. 765
The Water Supply of East Looe—A Water-Rate Difficulty—The Essex County Council and the Laindon Gas and Water Order—A Water Supply Problem from North Bierley 770
Kimberley Water-Works Company, Limited—Good Water Supply *v.* Electric Lighting at Madeira—The Price of Gas at Teignmouth—Bridgwater Corporation Water Supply—West Gloucestershire Water Company—Additional Capital for the Barnstaple Gas Company—Johannesburg Water-Works Company, Limited—Bognor Water Company 771

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

EDITORIAL NOTES.

The Affairs of the Commercial Gas Company.

THE meeting of the Commercial Gas Company last Thursday was poorly attended, in consequence of the day being the eve of the holidays. Mr. J. Blacket Gill, the Chairman of the Company, presided, and at the close of his address to the proprietors made suitable reference to the loss sustained by the Company in the death of Mr. F. Farnan, who, as we have already announced, is succeeded on the Board by Mr. E. T. E. Besley, Q.C. With a very different kind of feeling the Chairman spoke of the trouble caused to the Company by the policy of their big neighbours, the Gaslight and Coke Company, in storing their residuals on a falling market. We venture to observe that whatever injury is inflicted in this way upon the other London Gas Companies is a mere nothing to that which will have to be endured by the perpetrators themselves. Mr. Gill spoke well and to the point, as he always does; and especially was this pleasing attribute noticeable in the statement he made respecting the blunder of insisting upon the maintenance for London gas of an unnaturally high standard of illuminating power. No clearer pronouncement of the rights and wrongs of this matter has ever been made, even by a specialist, than that put upon record by Mr. Gill on this occasion. It used to be a commonplace of popular science lectures that an unpurified fuel gas ought to be placed at the disposal of the inhabitants of our large towns, in order that the nuisance of smoke from domestic fires might be prevented by the general use of gas-stoves. If for the word "unpurified" in this aspiration—the impracticable character of which has been demonstrated over and over again—the word "uncarburetted" is substituted, the ideal at once becomes realizable.

Mr. George Livesey spoke at the meeting—first, on the general subject of the public benefit that would accrue from the sale of uncarburetted gas; and, secondly, upon the particular question of the financial circumstances of the Commercial Company. We gather from his remarks upon the first head that, so far as he is concerned, he would be willing to consent to a reduction of the initial price of gas under the sliding-scale by an amount equal to the cost of carburetting, if the necessity for this delusive operation were abolished. It should not, one would think, be difficult for the London Gas Companies and the Metropolitan Local Authorities to agree upon this proposition, were it not that, as Mr. Gill justly says, the public seem to think that every proposition for change emanating from a Gas Company must be against the public interest. This is so obviously true, that we fully expect the question of uncarburetted gas for London to remain unsettled during the lifetime of the present generation of local magnates and gas administrators, and perhaps over that of their successors. This difficulty is aggravated, moreover, by the fact that, whereas the strength and ability to grasp a fundamental question of this kind exist on the Gas Companies' side, Metropolitan Local Government has descended to a day of small men. There is, however, at least one man of unexceptionable standing and disinterestedness, who might be trusted, even by the London County Council, to guide the authorities aright in a matter of this kind; and that is Lord Farrer. If the business ever got into the hands of the "small fry" of the County Council, it would never come to anything. But, with the goodwill of a London Gas Company, an experimental uncarburetted working for a term of years, with power of reversion, would be one way of allaying public suspicion as to the motives of those who advocate this reform. What with the day use of gas on the one hand, and incandescent lighting on the other, the case for carburetting is weakening daily.

On the financial condition of the Commercial Company Mr. Livesey offered some friendly advice which was well received by the Commercial chiefs. This Company, as is generally known, were well advised in 1875, by the late Mr. Robert Jones, to accept the sliding-scale before any of the other London Gas Companies; and they got it without the accompaniment of the auction clauses. Consequently, all their new 7 per cent. stock has been issued to the old proprietors at par; and since it now stands at something like 260, the advantage of this circumstance to

them is obvious. There yet remains £115,000 of this stock to be issued, every penny of which will cost the Company at least 10½ per cent., while it is actually being dealt in to return 4 per cent. There is, however, another side to the picture. This obligation to issue further new stock at par is practically a clog upon the progress of the Company; and it would be a benefit to everybody concerned, including the old proprietors, if it could be got rid of. The Board—to their credit and that of their Engineer and General Manager, Mr. H. E. Jones, be it spoken—are and have been most careful of their capital resources; and notwithstanding the pressure of what would appear to the average County Council mind an irresistible temptation to hand over to themselves and their friends the handsome bonus always at their command, they have succeeded in keeping their capital expenditure and charge on this account at the lowest of all the London Gas Companies. The time has come, however, when the undertaking is seen to be starving for want of capital to use and to spend. Yet the Board shrink from raising it, in the way to which they are entitled by law to have recourse, because of the excessive costliness thereof. Mr. Jones never spoke to better effect than he did on Thursday upon this point. He hopes to work the difficulty out as he goes along; and there is nothing else to be hoped for, so long as the bugbear of the shareholders' interest in their prospective stock allotments stands in the way.

Mr. Gill was justified in shaking his head over the proposal that the proprietors should be asked to relinquish this interest. But, frankly, we do not see why they should be asked to give up anything that is of any real value. It is perhaps arguable, however, that this deferred interest is not of much real value to them, after all; while it is a check upon the expansion of the undertaking, from which they would benefit considerably. The Company simply cannot afford to pay 10½ per cent. for fresh capital. To have to pay 7 per cent. would be bad enough; but, as the matter stands, the excess sliding-scale dividend has killed the prospective bonus which nominally the old proprietors are entitled to expect. Money must be raised for the purposes of the undertaking by any and every means other than this extravagant method. The reserve of borrowing power must first be exhausted; and when this money has been spent upon absolutely necessary works, the Company's bankers will still, as now, provide what is needed by way of working capital at a cheaper rate than the proprietors are entitled to receive for it. Anomalous state of things! It was the late Walter Bagehot, we believe, who first demonstrated that it is cheaper to trade upon borrowed capital than to use one's own resources. This is glaringly the case of the Commercial Gas Company at the present hour, and is likely so to continue for as long as practical persons need look into the future. Actually, the market does not recognize that the prospective bonus is of any tangible value; for the market price of Commercial stock is not so high as that of others to which no such condition attaches. We have discussed the proceedings at Thursday's meeting at exceptional length; but this is no more than their interest and importance call for.

The Coin Meter in Court Again.

An ill-regulated automatic prepayment meter has been the cause of some "unpleasantness" between The Gaslight and Coke Company and one of their consumers in West Ham, which is just the kind of locality for the application of the new system of encouragement in the use of gas, as is proved by the fact that there are some 4000 of these meters in the district. The Gaslight and Coke Company require those consumers for whom they provide a coin meter to sign an agreement binding them to pay, first, the current price for the gas supplied; and, secondly, such extra sum as rent for the use of the gas-fittings fixed by the Company as shall make up an aggregate rate of 3s. 4d. per 1000 cubic feet for the gas dispensed by the meter. Accordingly, these instruments are set to deliver 25 cubic feet of gas for every penny; but the Gas Company are careful to stipulate that the consumer must pay by the meter-index. This, one would think, should be enough warning to the consumer that the Company do not bind themselves to accept whatever cash there may be found in the box at any time as payment in full for the quantity of gas that has passed through the meter. It appears, however, that a meter used by Mr. Frederick Newton, a resident in West Ham, was discovered to have been unduly kind to its host and protector, for it gave him by the end of last year gas to the value of £1 2s. 7d. more than should have been passed upon the inducement of the pennies actually found in the box. Very naturally, on being spoken to on this subject, Mrs. Newton replied that "they had put pennies in the slot when the gas supply "ceased, and if they had burnt more gas than they ought "to have done, it was the Company's look-out." The argument would have been irresistible but for the existence of the agreement already mentioned, upon which, being recalcitrant, the consumer was summoned at the local Police Court, when the facts as above stated came out. The defence was based mainly upon the legal point that, by the nature of their agreement with the consumer, the Gas Company had debarred themselves from their statutory remedy in this Court, inasmuch as the action was not to recover an amount due for gas at the current price, but to obtain payment for gas supplied by contract at a special price. The case was adjourned; but it is evident that, if this is the correct reading of the law, the popularity of coin meters with Gas Companies, if not with consumers, will be considerably shaken.

This West Ham case has attracted the notice of the "Standard," which can usually be depended upon for taking the most stupid view of any matter of passing interest to be found in any London newspaper. In this instance, the commentary of our daily contemporary fully justifies its reputation; for it concludes with the quite gratuitous statement that "no authentic instance "has yet been brought to light in which a gas company "have detected one of their machines in an error favour-"able to themselves, and insisted on making good the "loss suffered by their customers." Doubtless the intelligent scribe who wrote this bit of elephantine pleasantry thought it very smart indeed. Gibes at the trustworthiness of gas-meters and the fair dealing of Gas Companies are, as all the world knows, the freshest and most original things to be found in the stock-in-trade of the journalistic humorist. This time, however, the exquisite wit of the "Standard" leader writer had no other apparent effect than eliciting an expression of surprise from a correspondent, who wrote from Hounslow to say that he has often received back coppers paid in excess to the local Gas Company for an automatic supply. It is, of course, obvious that if the writer in the "Standard" did not know of the existence of this practice, he knew nothing of the subject which he undertook to write about so brilliantly. This, however, is by no means an unprecedented condition in much of the journalism of to-day.

It is only worth while to mention this subject here in order that our readers may be still further warned, if this is necessary, as to the desirability of impressing upon their coin meter customers the condition under which this class of business can alone be carried on to the satisfaction of both parties. Consumers of gas in a small way are glad enough to get a coin meter; and they will submit to almost any terms for the accomplishment of their desire. This, of course, does not prevent them from trying to escape from these obligations the first moment it suits their purpose to do so. It is perfectly natural, also, as all gas managers will readily agree, for a small householder who has gone on helping himself to pennyworths of gas, in ignorance of anything being wrong with the coin attachment, to feel aggrieved when called upon to "pay up" a substantial sum as a correction of instrumental deficiencies. All this points to the necessity of patience being exercised in regard to the unavoidable incidental troubles of the introduction of what people generally forget to think of as a wholly novel experiment in the sale of gas. After all—to revert to the West Ham case—if the user of only one out of 4000 coin meters in this district has had a disagreement with the Gas Company, during the whole of last year, needing the intervention of the Magistrate to compose, the record is not one whereof the makers of these appliances need be ashamed.

End of the Hearing of the Incandescent Burner Lawsuits.

The incandescent gas-burner lawsuits were finished, with the exception of the judgment, on Wednesday last, when Mr. Moulton, Q.C., for the plaintiffs, addressed the Court in a speech of unexampled lucidity and power, even for him. The strain of these consecutive hearings, first of the De Mare, and then of the Sunlight case, has been specially great; and the very worst of it has necessarily come upon

the Judge, Mr. Justice Wills, whose sense of responsibility has at times wrung from his patience some pathetic appeals to Counsel to "cut it short"—appeals which do not seem to have had much effect. Mr. Moulton began his speech with an acknowledgment of the difficulty in which the nature of the proceedings put the Judge. He admitted also that there is such a thing as overdoing a contest of this kind—a proposition to which his Lordship gave ready assent. Immediately after this, the Judge declared himself perfectly satisfied as to the validity of the Welsbach patent; whereupon Counsel addresssed himself to the points of construction and infringement. We do not propose to paraphrase or summarize Mr. Moulton's observations, which must be read as we report them elsewhere, practically in full. Upon the conclusion of this speech, the opposition leader, Mr. Bousfield, showed, by the perpetration of a painful pun, that his vitality was not gravely affected. He said his friend Mr. Wallace pointed out on the previous day that "in the case of Queen Dido the "perimeter of her claim was measured by a cowhide;" and he suggested that "the perimeter of the plaintiffs' "claim should be measured by an oxide." Counsel did not know that this would "help his Lordship much;" but it at least enabled the Court to break up smiling. The vacation ends on the 13th, and judgment is expected on the following day.

Rumoured Abandonment of Coin Meters by the Chartered Company.

If the rumour is true, that the Directors of The Gaslight and Coke Company have decided to stop the issue of coin meters on the ground that they "do not pay," the news is of the very gravest importance for all the interests involved. The system was not favourably regarded at the Horseferry Road from the outset; but when the Chartered Board did adopt it, no words were too strong to express the Governor's satisfaction with the results. This applies to his address at the last ordinary general meeting of the Company. It would hardly be correct to describe the rumour, which would imply that Colonel Makins had gone back upon all these declarations, as surprising, because there is no knowing what the Horseferry Road autocrats may do from one day to another. At one time it is buying coal at top market prices; then it is binding the colliery agents not to sell to any other Company at less than Chartered terms. Now it is impossible, without agreement with the other London Gas Companies, to drop meter-rents; and the next step is to do it. Then coke and sulphate are amassed as though they were so much gold; only to keep purchasers in continual fear of buying elsewhere, lest they should awake some fine morning and learn that the whole had been given away, as the drapers say, "at an alarming sacrifice to clear." In a *soi-disant* "Department of State," something like continuity of policy should be shown. The operations of The Gaslight and Coke Company, apart from all pretension, are on so enormous a scale, and the movements of such a huge body acquire so serious a momentum, that there are the gravest dangers in its backing and filling and dodging about like a mere cockboat. In the present case, if the Chartered demands for coin meters, stoves, and fittings are suddenly shut down, the most acute trouble is certain to be experienced by the firms and workpeople who have been induced to make efforts to satisfy them. Besides this interest, however, which might be characterized as a selfish, if perfectly legitimate one, there is the great interest of the public, which is challenged by the vacillation of the Chartered Board. Always supposing the report above referred to is true, The Gaslight and Coke Company will be the first to relinquish the work of popularizing gas.

Eastern Counties Gas Managers' Association.—The fifteenth general meeting of this Association will be held on the 15th inst., at East Dereham. Two new members will be proposed for election; and the President (Mr. A. Drage), the Manager of the East Dereham Gas-Works, will deliver his Inaugural Address. This will be followed by a discussion on matters of general interest; and subsequently a presentation of a tea service will be made to Mr. Harry Wimhurst, in accordance with the resolution come to at the last meeting, on his retirement from the position of Honorary Secretary and Treasurer to the Association, in which he is succeeded by Mr. J. H. Troughton. At the close of the business, the members will dine together.

WATER AND SANITARY AFFAIRS.

The County Council have been warmly debating the question as to how their Transfer Bills came to be "killed." The report of the Joint Parliamentary and Water Committee, drawn up by their Chairman, Mr. T. M'Kinnon Wood, and presented at the Council meeting last Tuesday, laid the blame on the Government, as having insisted on the acceptance of terms of purchase which had always been regarded by the Council "as certain to involve the "ratepayers in an enormous expenditure beyond the value "of the undertakings." This, the report said, "has "caused the destruction of the Council's Bills and the "indefinite postponement of purchase." The Earl of Onslow, himself a member of the Parliamentary Committee, at the meeting on Tuesday, emphatically protested against being included in the "we" whose opinion was thus expressed. He considered that the Transfer Bills were lost because the Council refused to have them adjourned. If Mr. Stuart had consented to postpone the Bills, his Lordship believed the Council would have seen a way by which the existence of those measures might have been prolonged. A lively debate followed Lord Onslow's protest; and the controversy in the Council was rendered all the keener by a statement from Sir Arthur Arnold, who declared his conviction that if the Transfer Bills had proceeded, "a settlement by agreement "was not impossible." But the Bills were now gone; and Sir Arthur announced that, under present circumstances, he should not proceed with the negotiations. So much for the effect of a "Progressive" policy. The Chairman of the Council has seen the Directors of the Water Companies. He found them quite reasonable and eminently courteous, even though he "took firm ground." But his hopes of a settlement were suddenly scattered by the aggressive policy which compelled the Government to oppose the second reading of the Transfer Bills. Of course, Mr. Stuart and his allies will do their best to upset the Water Board Bill of the Government, though it cannot be said that it proposes anything to the detriment of the ratepayers. It even gives a degree of pre-eminence to the Council. But nothing satisfies the ruling spirits of that body short of having everything their own way.

The speech of Mr. George Banbury, the Chairman of the East London Company, at the half-yearly meeting of the proprietors on Thursday last, was specially interesting at its close, where reference was made to the "negotiations" initiated some weeks ago by the Chairman of the County Council on the subject of purchase. A very roseate view of his interviews with the Directors of the several Water Companies has lately been laid before the Council by Sir Arthur Arnold. But now, at last, we hear something from the other side; and this serves to show—despite the exultation displayed by Sir Arthur—that a considerable gulf continues to exist between the Council and the Companies. Mr. Banbury puts the case very clearly when he says that, so far as he could gather the views of Sir Arthur as to "what was fair," those views and his own "were very divergent." We could have expected nothing else; and we have been at a loss to understand how Sir Arthur could look forward to an agreement with the Companies, unless he felt himself able to convert the Progressives of the Council to ideas widely different from those which they have hitherto considered "fair and equitable" as ruling the terms of purchase. The Chairman of the Council may plead that the ardour of Mr. Stuart, in pressing forward the motion for the second reading of the Transfer Bills, and so causing their rejection, has necessitated the suspension of the negotiations. But we apprehend there was no likelihood that these approaches to the Companies would lead to any practical result; for, even though Sir Arthur Arnold might smooth the way, the policy of the Progressives would be sure to interpose a stumbling-block. One good result from Sir Arthur's interviews with the Directors consists in the favourable impression created by mutual courtesies. But, as Mr. Banbury intimates, there has been no business done, or even begun; and now, with the introduction of the Government Bill, Sir Arthur's "occupation" is gone. In the course of his address to the shareholders, Mr. Banbury referred to the mischievous character of the Height of Supply Bill, which the Joint Parliamentary and Water Committee of the Council

advised that body not to proceed with, but which is down for second reading a week hence. The Chairman also dwelt on the mischief wrought by the Council in subjecting the Company to needless expense in the shape of law charges incurred in the defence of their rights. But in despite of frost, drought, and the County Council, the Company are doing tolerably well, and they are rapidly improving their means of supply.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 770.)

As might be expected, in the portion of the week supposed to be devoted to business before the break-up for Easter, there was not much doing; everything was quiet to a degree. But it is a significant fact that, despite the inactivity, there was no sign of attendant depression, as is very often the case when prices do not meet with their ordinary measure of support. The general feeling was calm; and there was no tendency to take too black a view of our troubles either in the Soudan or in the Transvaal. So, unless any sinister incident should crop up meanwhile, there is reason to expect that the markets will reopen buoyant after their period of suspended animation. The Gas Market did not seem to suffer from inanition as much as some; and there was a very fair amount of business done, when all things are considered. Prices, too, were all in the upward direction; and several more or less considerable advances were effected in quotations. Gaslight "A" was conspicuous by pushing its recovery a couple of points further—the best mark of the week being 301. The secured issues also were in good demand; and both the 10 per cent. and 6 per cent. preferences commanded top figures. South Metropolitans were very strong, and realized high prices; the "B" advancing two points in value. Nothing at all was marked in Commercials. At the meeting of the Company last Thursday, some very pregnant remarks were uttered by the Chairman with reference to the standard illuminating power prescribed for the London Gas Companies, in which he was warmly supported by the Chairman of the South Metropolitan Company, who was present. As the points discussed very materially touch the interests of consumers as well as shareholders, it is to be hoped that they may attract the attention of the authorities. Smart advances among the Suburban and Provincial division were effected by Brighton and Bristol; the latter especially being now at a very choice figure. The Continentals were fairly active; but they made no change. Among the remoter undertakings, Melbourne Gas Bonds and Monte Video improved. The Water Companies were very quiet, and for the most part firm; though Southwark fell back a little.

The daily operations were: The Gas Market opened on Monday in good form; everything being firm, and high prices ruling all round. Gaslight "A" and South Metropolitan "B" improved 2 each; and Bristol, 4. Business kept up pretty well on Tuesday; and Brighton and Hove ordinary advanced 2. Wednesday was a bit quieter, and no change was made in quotations of Gas. But Southwark Water receded 2. Thursday was the most active day of the week. Monte Video improved ½. In Water, Lambeth 7½ per cents. and West Middlesex were 2 higher.

ELECTRIC LIGHTING MEMORANDA.

The Meeting of the Metropolitan Electric Supply Company—Competition in Electric Supply—Electricians in Council upon High-Voltage Lamps.

THE ninth ordinary general meeting of the Metropolitan Electric Supply Company, Limited, was held this day week, under the presidency of Sir Eyre M. Shaw, the Deputy-Chairman, in the absence through illness of the Chairman of the Company, Sir John Pender, to whose wisdom and knowledge in matters of electric industry this undertaking owes much of its prosperity. The Chairman of the meeting spoke of the continual growth of the Company's capital expenditure as being due to the necessity of making provision for the constant extension of the business. Certainly the business is a growing one; but it would be interesting to know the capital cost of the new lamp connections as compared with the average over the old establishment. Last year the revenue for current sold showed an increase of £21,101, as compared with the increase of £16,150 for 1894, which goes to indicate that the point of saturation of the district is not yet reached. The most interesting incident in the past year's history of the undertaking was the fire which occurred at the Sardinia Street station on June 24. Fortunately for the Company, this mishap occurred at the season of lightest load; so that by means of their own system of trunk mains connecting the different stations, and by the help of other electricity supply companies having more generating power than they wanted, the Company were able to continue to fulfil their obligations to their customers. The incident was not an unmitigated evil; for, as we remarked at the time, it gave a welcome opportunity for a thorough overhauling and modernization of the station plant. The insurance companies, of course, did not like it; and although they are reported to have settled up satisfactorily, they are "taking it out" of the electric lighting industry in general by increased premiums.

The Chairman referred, as in duty bound, to the competition with which the Company are now confronted in their Strand district. He admitted that this competition (with the Charing Cross Company) has always existed in the adjacent St. Martin's district; but, inasmuch as both Companies commenced operations practically at the same time, he does not consider that his own Company had any legitimate cause for complaint on this score. In the present case, however, the Metropolitan Company's Board regard competition as unfair, because it comes after they have succeeded in building up a large and important business through their own unaided exertions. But one would be disposed to think that in such a case they must have less reason to fear competition, supposing it to continue of the same character as that which has from the first attended them in the next parish. Incidentally, the Chairman made an admission that bears upon the crucial question of the comparative advantages of the alternating and direct current systems of supply. Some proprietors inquired why the Company's coal consumption is so large; and the answer was that "they had a class of main which cost them very little, and their coal consumption was high; while other companies had paid a great deal for their mains, and their coal consumption was lighter." This explanation seems to point to there being a loss of energy somewhere in the alternating system of supply from which direct-current systems are free—probably in the transformers.

The latest information on the subject of high-voltage lamps, supplementing that contained in Mr. Addenbrooke's paper, mentioned in this column a fortnight ago, is to be found in the discussion upon the same paper reported in the "Electrician" for the 27th ult. Mr. J. W. Swan admits that the 220-volt 8-candle lamp is a more fragile thing than the 110-volt lamp of the same power as at present made, as well as rather more costly to manufacture. He hoped the ardour for progress in this direction might not lead to the adoption of lamps requiring double the voltage of the lamps now in use in connection with existing installations, without a thorough overhauling of all portions of the installation, including the house wiring. With regard to the alternative improvement, of the high-efficiency lamp, Mr. Swan pointed out that the real difficulty in the way lay not so much in the lamp itself as in the conditions under which it must be used. The fluctuations of pressure to which lamps are subjected are too great to give a high-efficiency lamp anything like a fair chance of life. Mr. C. H. Stearn made a curious complaint against lamp users, that while not expecting the laws of gravity to be suspended in their favour when dealing with gas, they had decided that the (incandescent) lampmaker must so completely triumph over gravity as to enable his lamps to be used in any position. Did Mr. Stearn never see a gas-flame burning in a horizontal or inclined position? If not, we can assure him that this is a very common requirement in gas lighting, and has to be conformed to for a variety of reasons, although gas engineers know that, with the exception of regenerative burners, flames placed out of the vertical suffer a notable loss of illuminating power. The object of placing an incandescent electric lamp in an inclined or horizontal position is twofold—for the sake of appearance, and with the object of improving the downward lighting effect. Such positions doubtless strain the filament; but they are necessities of the case that must be met. Very naturally, the alternating-current men do not see the advantage of the 220-volt lamp, for use with the direct-supply current. Thus Mr. W. Geipel thinks that, given all that can be claimed for the economy of the 220-volt standard of pressure, an alternating current installation will always give a 100-volt supply to the consumers at a lower rate. This speaker roundly denied that there has been any real improvement worth particular mentioning, in the manufacture of incandescent electric lamps during the past ten years. Of course, the price has been reduced; but the lamps are only fractionally better, in the economical sense, then they were ten years ago. He thinks the 200-volt lamp policy "mere subterfuge, which should be strongly opposed." "Why," this candid electrician went on to ask, "were people adopting the Welsbach gas-burner? Simply because they got a good light for half the consumption of gas. If, then, they wished to compete with the Welsbach—and it was a serious competition—they must give the consumer a lamp which took less watts. . . It was his opinion that the popularity of the electric light would be distinctly and unfavourably affected if they forced upon the consumer a 200-volt supply." Another speaker confessed that, in order to compete against gas, it is necessary for electricians to carefully consider the question of cost; and he admitted that the only way of doing anything in this direction was to reduce the illuminating power of consumers' lamps to 8 candles, and work in 3-candle lamps wherever this can be done. They would then reduce the electric account to "something reasonable." The speaker forgot to state whether the same character would apply to the lighting, and what would be the effect upon such a carefully modulated system of the comparison of a few incandescent gas-burners next door.

THE PRODUCTION AND USE OF CALCIUM CARBIDE.

We learn that the Acetylene Illuminating Company, Limited, of 63, Queen Victoria Street, E.C., who hold a license under the Willson's patents for the manufacture of calcium carbide and the supply of acetylene gas, have made arrangements with the British Aluminium Company by which the Acetylene Company obtain control of the Cowles and various other patents dealing with electrical furnace work so far as the manufacture of calcium carbide is concerned. It appears that the Acetylene Illuminating Company have for about a year manufactured calcium carbide on a fairly large scale; but they have hitherto been unwilling to sell to the public either the carbide or apparatus for gas generating, as they felt it necessary to carry out exhaustive experiments as to the explosive nature of acetylene gas, the best methods of compressing, its influence on various metals, and (especially) the best class of burner to be adopted for general use. The carbide was first supplied by Mr. Samson Fox, who heard of the process of manufacture when in the United States in August, 1894, and who brought over to this country a large quantity of the carbide, as well as apparatus for generating the gas. The Acetylene Illuminating Company was afterwards formed as a private Development Company; and we learn that the difficulties that had to be overcome—both in the economical manufacture of the carbide, and in the general application of acetylene gas—have so far been met that the Company have decided to erect large plant for the manufacture of calcium carbide to be used, in the first instance, for railway carriage lighting, tramways, lighthouses, and private houses where coal gas cannot be obtained. We are pleased to know that the Acetylene Company do not claim that acetylene gas will at once produce a revolution in lighting; and if they continue to proceed quietly and cautiously to work, we believe that the new illuminant has a considerable future before it. It is certainly unfortunate for Mr. Willson, that he should have applied for one of his patents in this country on the wrong Patent Office form; but it was scarcely to be expected that the mistake would be rectified by Parliament—involving as it did the nullifying of existing rules made by the Controller of Patents. We can quite understand that the Committee of the House of Lords should, in giving their decision, have said that they were very sorry for Mr. Willson; and we are told that the opposition to the Bill by Messrs. Read Holliday & Sons and others—to which allusion was made in the "Journal" last week—had, in all probability, nothing to do with the rejection of the Bill. The matter will certainly not end here, as the Acetylene Company maintain that their position is an extremely strong one.

THE PHILOSOPHY OF POLITICS AND ADMINISTRATION.

(*Continued from p.* 684.)

We cannot follow the author in his inquiry into the operation of democratic ideas in Spain and France. Yet it is impossible to deny the cogency of the proofs adduced as to the mischievous results of universal suffrage in the latter country, which lead up to the assertion that "the forms of corruption which are practised in a pure democracy are in general far more detrimental to the prosperity of nations than those which existed in other days." Corrupt governments, of the old-fashioned type, are not necessarily extravagant; whereas "wars, overgrown armaments, policies that shake credit and plunder large classes, laws that hamper industry, the forms of corruption which bribe constituencies or classes by great public expenditure, by lavish, partial, unjust taxation—these are the things that really ruin the finances of a nation." Politicians of a certain brand are fond of dilating upon the cost of courts and princes; but this is nothing to the loss endured by the country which falls into the hands of revolutionary adventurers.

From France Mr. Lecky takes his readers to the United States, and shows them how democratic institutions work there. He is eloquently condemnatory of the "spoils" system, and has much that is interesting to tell of the corrupt way in which the United States cities are governed. This comes out in our columns occasionally, in connection with the gas supply. But Mr. Lecky justly says that acquiescence in corruption is worse than corruption itself; and with this sin he charges American public opinion. After many pages filled with painful reading of this kind, the author returns home; and, although inclined to shake his head over certain recent parliamentary developments, he comments with justifiable complacency upon "the admirable corporate government which has sprung up in our great towns. It is very doubtful," the scholar and historian declares, "whether the spirit of municipal and local patriotism was more strongly developed either in ancient Greece, or, during the Middle Ages, in the great towns of Italy and Flanders, or along the Baltic, than it now is in Birmingham, or Liverpool, or Manchester. The self-governing qualities that are displayed in these great centres, the munificence and patriotism with which their public institutions are supported, the strong stream of distinctive political tendency that emanates from them, are among the most remarkable and most consolatory facts of English life. In France, the ascendancy of Paris has almost atrophied political life in the provincial towns; and the capital has again and again shown itself sufficiently powerful to reverse the decision of the country. In America, the corruption of municipal government in nearly all the more important cities is the worst side of the national life. England has hitherto escaped both of these evils; and the political weight of the chief provincial towns is unquestionable. The Manchester school of the last generation, and the Birmingham school of the present generation, have been among the most powerful influences in modern politics." The author points to the telegraph as a decentralizing agency, tending to keep up the independence of provincial towns, and more especially limiting the influence of London newspapers.

Proceeding from politics to economics, Mr. Lecky descants upon the love of democracy for authoritative regulation. "The two things that men in middle age have seen most discredited among their contemporaries are probably free contract and free trade. The great majority of the democracies of the world are now frankly protectionist; and even in free-trade countries, the multiplication of laws regulating, restricting, and interfering with industry in all its departments is one of the most marked characteristics of our time. . . . A school has arisen among popular working-class leaders which no longer desires that superior skill, or industry, or providence should reap extraordinary rewards. Their ideal is to restrict, by the strongest Trade Union regulations, the amount of work, and the amount of the produce of work, to introduce the principle of legal compulsion into every branch of industry, to give the Trade Union an absolute coercive power over its members, to attain a high average, but to permit no superiorities. The industrial organization to which they aspire approaches far more nearly to that of the Middle Ages—of the Tudors—than to the ideal of Jefferson and Cobden. . . . It may be permitted to doubt whether liberty in other forms is likely to be very secure, if power is mainly placed in the hands of men who, in their own sphere, value it so little." The expansion of the authority and the multiplication of the function of the State in other fields is an equally apparent accompaniment of modern democracy. It is the author's opinion that the modern English "Progressive" ideal is a system under which one class will impose the taxes, while another will be mainly compelled to pay them. The headings to the pages on which these observations occur, are on the one side the title of the book, "Democracy and Liberty;" on the other, "Democracy is not Liberty."

Mr. Lecky does not think highly of the business capacity of modern Parliaments; but he is an admirer of the Parliamentary Committee system, which he thinks might with advantage be considerably extended and include the principle of devolution. He considers that the expense of carrying to London great masses of non-political private business which might be as efficiently and much more cheaply settled at home, is a real and serious grievance; while the obstruction to parliamentary business caused by the introduction of many matters that ought never to be brought before the Supreme Legislature of an empire, is keenly felt. Sooner or later some change in this system must be effected; and a much larger proportion of Irish and Scotch business than at present is likely to be entrusted to bodies specially representing those countries. Subject to certain reservations, the author approves of a large extension of local government. He regards it as of the first importance, however, that the power of raising and spending rates should be closely bound up with the liability to pay them. Hence the modern abolition of the property qualification for the electors of local authorities is regarded as a misfortune, especially in view of the tendency of local taxation and indebtedness to increase. "The complications of local taxation are so great, that it is probably not possible to obtain complete accuracy on this subject; but there can be no question of the appalling rapidity with which the movement has advanced." Unfortunately, the very tendencies that make it so dangerous increase its popularity.

Mr. Lecky observes that he knows few things more melancholy or more instructive than to compare the present state of Europe with the predictions of the Manchester school, and of the writers who, within the memories of many of us, were looked upon as the most faithful representatives of advanced thought. He refers to the enthusiasm and admiration with which, in 1857, the first volume of Buckle's great "History" was welcomed. This was the new evangel of the Progressives of that day. It predicted, among other things, that the military spirit had had its day, and that the "commercial spirit," which is "now invariably pacific," would speedly reduce it to insignificance. Nothing could have been more mistaken. Militarism has taken a new lease of life from having been fresh rooted in the very soil; and Mr. Lecky, anticipating the verdict of the members of the iron trade deputation that recently visited Germany, agrees that there is much to be said for the view that universal military service is a positive good rather than a necessary evil. He does not, however, accept it as the whole truth. Granting, as the deputation discovered, that discipline has an industrial as well as a military value, he observes that it also represses much; and the dead level and passive obedience of the military system are not the best school of independent thought and individual energy.

With regard to the modern tendency to enlarge the responsibilities of Government, Mr. Lecky remarks that all excursions outside the natural sphere of State action should be carefully and jealously watched. But he admits that there are some distinctions which should not be forgotten. "Government

enterprises which are remunerative, stand on a different basis from those which must be permanently subsidized by taxation, or, in other words, by forced payments, in most cases largely drawn from those who are least benefited by them. If it be shown that the State management of some great enterprise can be conducted with efficiency, and at the same time made to pay its expenses, or if it can be shown that, by the excellent credit of the State, a State loan or a State guarantee can effect some useful change, or call into being some useful enterprise without loss to the State or to its credit, a large portion of the objections to this intervention will have been removed. It is also very important to consider whether the proposed intervention of the Government lies apart from the sphere of politics, or whether it may become a source or engine of corruption. It may do so by placing a large addition of patronage in the hands of the Executive; and it may do so still more dangerously by creating new and corrupt reasons for giving or soliciting votes. Few persons, for example, can doubt that, if the Socialist policy of placing the great industries of the country in the hands of municipalities were carried out, numbers of votes would be systematically given for the sole purpose of obtaining advantages for the workmen connected with these industries, at the cost of the community at large."

The author believes that the functions of government must inevitably increase with a more complicated civilization; but the enormous and portentously rapid extension of these developments of late years, and the increase of taxation that has attended them, go to show that democracy has become, in nearly all countries, a government of lavish expenditure, of rapidly accumulating debt, of constantly extending State action. This is how democracy works; and when the fact is recognized, it may be possible to put a check upon it. Again, part of the costliness of democratic government is traceable to its increased elaboration of administrative machinery for purposes of inspection and regulation. "Nothing is more characteristic of the New Democracy than the alacrity with which it tolerates, welcomes, and demands coercive Government interference in all its concerns." Few things would have more astonished the old politicians of the Manchester School—the Progressives of their day—than to be told that their "advanced" successors would be distinguished for their clamouring for regulation in all the affairs of life. Another evil of democracy which Mr. Lecky discerns is the rapid multiplication of the idle rich. "The tendency of most great forms of industry is evidently towards vast joint-stock companies with many shareholders. . . . It will appear probable that the fortunes of the future will be much less connected with active duties than those of the past."

In the course of a survey of modern politics in England, through which we cannot follow him, the author notices a strengthening tendency in the direction of attempting to win votes by class bribery. "With large democratic constituencies, in which a great proportion of the voters are quite indifferent to the main issues of party politics, some form of corruption is certain to arise." The form which has shown itself most conspicuously in our large democratic local authorities up to the present time is that of "legislating away the property of one class and transferring it to another." It would not be an undue forcing of this generalization to place within the category the policy of the majority of the London County Council in regard to the London water undertakings. This party knows that its mass of heterogeneous supporters cannot be interested in those prosaic details of administrative duty which constitute the bulk of the proper work of such a body; and accordingly the suffrages of the populace are sought by the expedient of dangling before their eyes the bait of a specious proposal for confiscating the property of the Water Companies.

It is not surprising to discover that Mr. Lecky disapproves of the abolition of the London coal dues. "Not one Londoner in a hundred even knew of the existence of the small duty on coal which was abolished by the London County Council. It had existed in one form or another for more than six hundred years, and was almost the oldest of our taxes. It furnished an income of more than £500,000 a year, raised without complaint, for the purpose of effecting Metropolitan improvements; and there is no reason to believe that any human being, except a few rich coalowners and middlemen, derived any benefit from its abolition." Here again Mr. Lecky, as it appears to us, has betrayed inability to distinguish between those who actually pay a tax, and those upon whom the weight of it ultimately falls. A little more inquiry into the facts would have enlightened the author as to the effect of the removal of the coal dues upon the Metropolitan trade in coal, coke, and gas; while he would have learnt that, as a matter of fact, not the London County Council but Parliament was responsible for allowing them to lapse. Moreover, he has failed to appreciate the point that the continuance of such a source of indirect taxation would have been an incentive to extravagance on the part of the London County Council, and have been in direct opposition to his own doctrine that those who spend public money should be constrained to feel the pinch of raising it.

(*To be continued.*)

Russian Petroleum.—Rich deposits of petroleum have been discovered in the Bibi-Eibat district, Russia. A daily production of 250,000 poods has been already attained.

PERSONAL.

Mr. A. C. Pain, M.Inst.C.E., has been entrusted with the preparation of plans for new works for the Farnham Water Company at Gravel Hill.

Mr. Hartwell Conder has joined the Board of the Bognor Water Company, *vice* Mr. A. Hayes, who has resigned his position in consequence of pressure of other duties.

M. Berthelot, the distinguished French chemist, who accepted office as Foreign Minister on the formation of the Bourgeois Administration last November, as mentioned in the "Journal" at the time, has resigned, as the result of recent political events in France. M. Berthelot was Minister of Public Instruction in M. Goblet's Government.

Mr. W. H. Collins, the Gas Analyst to the Bolton Corporation, has resigned that position, owing to the passing of resolutions by the Gas and Electricity Committee—calling upon him, in consequence of complaints as to the quality of the gas, to make analyses in the presence of the Works Sub-Committee, and requesting him to present weekly reports of analyses.

NOTES.

Sulphate of Ammonia and Hay Crops.

Some important experiments have been carried out in the counties of Cumberland, Durham, and Northumberland, to ascertain the value of land dressings in agriculture; and a report has been issued dealing with the trials on 1145 plots, covering more than 83 acres. The experiments have been carried out under the supervision of Professor Somerville and the staff of the Durham College of Science. From the results already ascertained in respect of hay, nitrate of soda brings out the highest results. But, of course, this is a dressing which, after a few years' use on the same land, loses its value; and it is therefore necessary to use it with potassic and phosphatic manures. The opinion is becoming more and more general that sulphate of ammonia, ¾ cwt. of which is roughly reckoned as being equivalent to 1 cwt. of nitrate of soda, is an advantageous substitute for the latter; but the report indicates that in these proportions the best results will be derived from nitrate of soda—a point which those who are pushing the use of sulphate should not leave out of their calculations, as a too meagre dressing with this agent may bring about a poor crop, and consequently a bad repute for the manure. From the experiments in question, the chief conditions under which sulphate of ammonia may be expected to exhibit superiority are in a wet climate or on light land. But, all things considered, Professor Somerville inclines to the opinion that the safest plan would be to use a mixture of both in the proportion of four of nitrate of soda to three of sulphate, rather than to depend upon either alone; while the remarks concerning the use of nitrate of soda in conjunction with phosphates and potash apply likewise in the case of sulphate of ammonia. A strong caution is given against mixing sulphate with basic slag. Professor Somerville recommends the following dressings per acre on hay land where no dung is applied (it being, of course, understood that each dressing stands by itself, and that the Professor does not mean them to be mixed in these proportions): Superphosphate, 1½ cwt.; basic slag, 1 cwt.; dissolved bones, ½ cwt.; kainit, 2½ cwt.; nitrate of soda, ¼ cwt.; sulphate of ammonia, ¾ cwt. The last two dressings are most effective when applied about the end of April.

The Waste of Steam Boilers and Engines.

In a Franklin Institute paper on the prevention of waste of heat in steam-raising practice, Mr. William Kent stated that the efficiency of good boilers using the best ordinary fuel may be taken at 75 per cent., which would be the figure worked out from the ratio of theoretic fuel efficiency to the actual evaporative efficiency. The best Corliss triple-expansion condensing steam-engine takes 12½ lbs. of steam per horse power, which represents an efficiency of 18·68 per cent. The combined efficiency of boiler and engine is therefore 14·01 per cent. So that, in the best modern type of engine, we obtain only one-seventh of the heat-value of the coal used; the remaining six-sevenths are absolute waste. But so far as existing knowledge extends, this waste is non-preventible. There does not seem to be any possibility of greatly reducing the waste in the steam-engine, so that its steam consumption will be less than 12½ lbs. per horse power per hour. In all steam-engines, we must throw away either hot steam, as in high-pressure engines, or a vast volume of hot water, as in condensing engines; and in the latter case there is no known way of recovering the heat from the water that is thrown away, so as to use it again in the engine. It may be left for the next century to discover some means of obtaining mechanical energy from coal without the intervention of the steam-engine; but there is no present prospect of such an invention. Meanwhile, the gas-engine is a less wasteful motor than the steam-engine, although it has waste of its own, and, like the condensing steam-engine in another way, wastes a great deal of heat in warming water that cannot be utilized either directly or indirectly.

Professor Witz on Cheap Engine Gas.

Discussing the production of cheap gas for driving gas-engines, Professor Witz states that all the different varieties of semi-producer gas are based on the experiments of Ebelmen in 1843, and of Thomas and Laurent. In none of them is there any fresh principle, and all conform to a few essential points. It is recognized that the producer must be kept hot, otherwise tarry matters deposit; and a blast of some kind is indispensable. Generally, the more steam can be worked into the gas, consistently with keeping up the heat, the richer will be the product. A pound of steam to a pound of Welsh anthracite is the usual standard of practice. In order to make a gas capable of being used to drive a gas-engine, something better than Siemens producer gas must be prepared; and this can be done by either the Dowson or the Lencauchez system. The value of the latter consists in its ability to gasify poorer fuel than the Dowson plant. Two new forms of engine-gas generators have recently appeared in France—the Gardie and the Bénier. In the former, the air supply is first separately compressed, and injected with steam at a pressure of seven atmospheres. A rich gas is said to be prepared in this way, without tar or ammoniacal products; but the apparatus has scarcely passed the experimental stage. In the Bénier system, the engine draws the gas it requires directly from and through the generator, which is much simplified. The consumption of fuel in this system is stated to be about 1·3 lbs. per brake horse power per hour. The best result of the working of the "Simplex" gas-engine of 300-horse power at Pantin, with Buvie-Lencauchez generators, is a fuel consumption of 1·1 lbs. of Anzin coal per brake horse power per hour.

The Durability of Paints.

Some researches upon the value of different descriptions of paint for ironwork have been made by Professor Spennrath; and an account of the principal results obtained has been published in the "Deutsches Bauzeitung." As one result of his investigation, Professor Spennrath concludes that none of the metallic oxides commonly used as pigments combines chemically with linseed oil. The phenomenon of drying is brought about exclusively by the absorption of oxygen by the oil; and though the presence of the pigment facilitates this, it is in a purely mechanical way. The value of different pigments varies considerably. Thus zinc white, when used for outside work, rapidly swells to twice its original volume, owing to the absorption of carbonic acid and water. Sulphuretted hydrogen will cause red and white lead to act in a similar way; but when they are pure, Professor Spennrath considers these two pigments satisfactory. Carbon paints are very stable; and so is paint made of heavy spar, although the covering power of the latter is small. In order to test the relative durability of different paints, sheets of zinc were coated with a selection of various kinds, and the zinc was subsequently dissolved away by acid—leaving the film of paint behind. It was found that all these films could be destroyed by the action of dilute nitric or hydrochloric acid, as well as by sulphuric and acetic acid vapour. Alkaline fluids and gases also destroyed the paints rapidly. Pure water was found to be more destructive than salt water; and hot water, of course, was more active than cold. The influence of temperature on the durability of paint was found to be very great. Films such as have been described completely lost their elasticity and became brittle when exposed to a temperature of 203° Fahr. At the same time they contracted strongly. Prolonged exposure to considerably lower temperatures had a similar effect. Blistering was proved to be due to the application of a second coat before the first had thoroughly hardened.

Gas-Ovens for Disinfecting Books.

The old question of the influence of public libraries in disseminating disease infection has been again raised by a report by Drs. Du Cazal and Catrin, of the staff of the Pasteur Institute, who show that the leaves of a book soiled by streptococcus pus, pneumonic pus, and expectoration, or by the diphtherial false membrane, were able, after several days, to transmit these maladies to animals. In regard to the question of how far it is possible to disinfect books that have become charged with a contagium, the authors show that there are considerable practical difficulties in the way of such an operation. Of chemical disinfectants, they prefer the vapour of formic aldehyde in which calcium chloride has been dissolved, which confers complete protection except with regard to typhoid fever. The disinfection was most perfect and complete, however, by exposure to high-pressure steam. This method unfortunately has the disadvantage of destroying the bindings of books. Books that are merely stitched, in the usual French manner, passed through the ordeal by steam uninjured; no harm being done either to the paper, the ink, or even to coloured engravings. In this connection, it may be asked whether an arrangement by which library books could be passed through a gas-oven would not prove efficacious from the sanitary standpoint. Not all kinds of bindings could be safely subjected to such treatment as that which we have described above; but neither paper nor millboard would be injured by exposure to a dry heat sufficient in intensity and duration to destroy the vitality of most if not of all disease germs.

COMMUNICATED ARTICLE.

ADVANCES IN TECHNICAL GAS ANALYSIS.

By G. E. Brown, A.I.C.

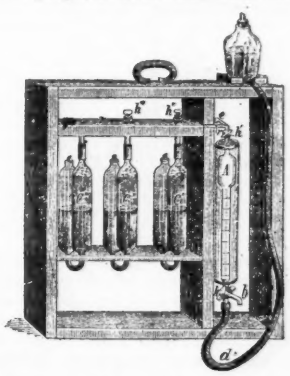
The apparatus employed in technical gas analysis can hardly be said to have arrived at such a state of perfection as to render further improvement unnecessary. The following improvements in the Orsat-Muenke apparatus, and in apparatus for titrating gases, are due to Herr O. Bleier, and were recently communicated by him to the "Deutschen Chemischen Gesellschaft."

I.—Automatic Measurement of Gases Saturated with Water Vapour: Modification of Orsat's Apparatus.

The influence of the tension of water vapour on the volume of gases under otherwise equal pressure, is well known to be of sufficient importance to justify taking it into consideration in technical gas analysis. In order to avoid all errors arising from it, it is necessary that the gas under examination should be saturated with water vapour throughout the whole analysis. This can be done—even in the case of easily soluble gases—if, on streaming the gas under examination into the measuring-tube filled with water, the water is expelled from the latter through a fine aperture only so slowly that the drops of water which would otherwise remain clinging to the walls of the tube are carried down by the slowly sinking level of water. The slight quantity of water adhering to the walls of the tube, suffice to fill the space with water vapour, while, on the other hand, it is saturated, even by an easily soluble gas, by passing the latter through for a few seconds. I have already dealt with the application of this principle of measuring gases to gas burettes.* It is a principle which should be applied in consequence of the advantages (saving of time, greater accuracy, and extended applicability of apparatus) which it offers in the use of all the apparatus in which volumetric analysis of easily and difficultly soluble gases are made—such as J. Coquillon's carburometer and grisoumeter, the Bunte-Seger gas burette, and the instruments of Scheibler, Max Liebig and Lindemann, &c. The following is a description of the application of this principle to Orsat's apparatus, which I have also so further modified as to make it possible to obtain with it results as accurate as those realized in a gas burette with a water-jacket.

Modification of Orsat's Apparatus.

This modification of Orsat's apparatus is based on the form made by Robert Muenke.† It differs, however, from that instrument in the following respects: At the lower end of the measuring-tube A is a three-way cock, by which communication can be made with the flexible tube *d* or with the horizontal glass tube *b*, which projects from the front of the apparatus.



This latter tube serves for the escape of the water from the measuring-tube, and is drawn off to a fine aperture, so that the water requires from two to three minutes to escape from the measuring-tube. To the upper end of the tube A, a two-way cock h^{I} is attached, which connects either with the glass tube *r* or with the horizontal capillary tube *c*, which is turned towards the back of the apparatus, and serves to convey the gas from the gasholder to the tube A. The measuring-tube holds exactly 100 c.c. between its two glass cocks. The horizontal glass tube *r* is provided with a two-way cock at its junctions with the capillary tubes from c_{I}, and c_{II}. c_{III} does not need to be shut off by a separate cock. The further details of the apparatus are identical with those of the Orsat-Muenke pattern.

After the measuring-tube has been filled with water, it is necessary to allow the gas under examination to enter at *c*, while the trapping liquid escapes from *b*. Now first close the cock h^{I}, and then by turning the cock *h* connect the measuring-tube with the bottle on the top of the apparatus. The absorption can now commence without further measurement; the gas being passed into C by turning the cocks h^{I} and h^{II} into the necessary positions. The further course of the analysis is conducted in the usual way.

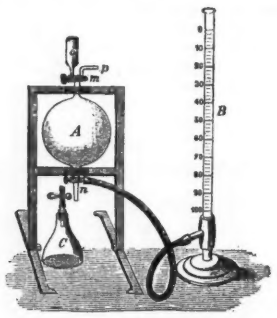
The advantage of this modification is threefold: (1) Saving of

* See "JOURNAL," Vol. LXVI., p. 1036.
† See Butterfield's "Gas Manufacture," p. 180.

time, and a higher degree of accuracy, in consequence of the automatic measurement of the gas. Moreover the solubility of the gas under examination in the trapping fluid can give rise to no errors. (2) The apparatus can be used for the analysis of easily soluble gases. Attempts have already been made to solve this problem. Ferd. Fischer recommends using petroleum as the trapping fluid for the estimation of the whole of the acid (SO_2 and SO_3) in furnace gases; but this is only partially successful, since—apart from the errors due to the tension, and the viscosity of the petroleum—the solubility of the gases in the petroleum is not after all so small as it has been commonly regarded. This fact has been pointed out by St. Gniewosz and H. Walfiscz. (3) Analyses can be made in the above apparatus as accurately as in a gas burette, since by allowing the gas to enter the measuring-tube directly (at *e*), a source of error is removed which exists in all previous modifications of Orsat's apparatus, in which the gas enters the apparatus at the end of the tube *r*. The usual method of avoiding this error—viz., exhausting the tube *r* before passing the gas into the absorption pipettes—is altogether useless, because, even when this is done, the portion of the gas remaining behind in the tube *r* is a source of error which falls most heavily upon the carbonic oxide estimation, and least heavily upon the carbon dioxide estimation. In the above apparatus, however, the tube *r* only contains at the commencement of the analysis the gas (nitrogen and marsh gas) left from the preceding experiment, which cannot give rise to any error, since its volume is not altered by treatment in the absorption pipettes.

II.—*Apparatus for Titrating Gases.*

The usual apparatus for titrating gases only allows the estimation of a single constituent of the gas, and not a full analysis to be made. In the apparatus described below, the titration of the gas can be combined with a complete volumetric analysis (by absorption and explosion). Analysis by absorption can also be made with it somewhat more accurately than with a gas burette. For simple gas titrations, the apparatus figured below gives more accurate results than W. Hesse's apparatus, in which the measurement of the gas is liable to a small error in placing the caoutchouc stoppers in their prescribed places. Errors may also arise in the use of Hesse's apparatus from gas diffusing through the caoutchouc; and from the occasional removal of the stoppers during the analysis, and alterations in temperature from the unavoidable handling of the apparatus. These defects are avoided in the following apparatus, the accuracy of the results obtained with which are limited only by the sensitiveness of the solutions used in titrating, and the degree of accuracy of reading.



Description of the Apparatus.—This consists of a glass globe A carrying the two-way cock *m*, which connects with the glass cup *o*, or with the capillary tube *p*, and the three-way cock *n*. The globe (which holds about 500 to 600 c c.) is fastened with metal strips to an iron frame. Its exact content between the two stopcocks must be known. The tube B, which is fixed to a wooden or iron foot, serves as a levelling and measuring vessel. It holds 100 c.c., and is divided into fifths of a cubic centimetre. It is joined by means of 75 cm. of flexible tube to the three-way cock *n*. For removing liquid from A, a previously exhausted Erlenmeyer flask is attached to the nozzle of the three-way cock.

Manipulation.—First dry the globe (if desired with alcohol and ether), and allow the gas under examination to enter at *p* or *n* according as it is heavier or lighter than air. After from $3\frac{1}{2}$ to 4 litres have passed through, the operator may rest assured that the air has been displaced. Now close first the cock from which the gas is escaping, and then the other; and then allow the gas to stand for some time under increased pressure. Meanwhile take the temperature and height of barometer in the neighbourhood of the apparatus. After about five minutes, the gas will have come to the temperature of the room. Now open one of the cocks, so as to allow the excess of confined gas to escape, so that there remains a certain volume measured at atmospheric temperature and pressure. This measured volume—the volume of the glass globe—is now reduced to 0° and 760 mm. if the solutions to be used for titration are formulated on that corrected basis. The operator now proceeds to introduce the reagent for absorbing the constituent of the gas which it is desired to titrate. Absorption reagents, the quantity of which added need not be known (such as water for HCl and NH_3, and NaH CO_3 for SO_3), inasmuch as since the standard solution subsequently added reacts directly with the gas dissolved by them, are simply allowed to flow in from the glass cup. But such absorption reagents as baryta water for CO_2, and caustic potash for other acid anhydrides, which require to be added in known excess must be placed in B. A small quantity is first permitted to escape from the nozzle of *n*, in order to expel all air bubbles from the flexible tube. A measured quantity is then allowed to enter A. When absorption is complete, the reagent is removed from the nozzle of *n* to the exhausted flask C, rinsed out with water, which enters from the glass cup, and the liquid titrated in the usual manner. The volumetric analysis of the gas can now be made in the apparatus itself or the residual gas led, as out of a gasholder, into Orsat's apparatus or into a gas burette, and then analyzed by absorption or explosion. In either case, the results obtained must be multiplied by a factor, $3 = \frac{100 - p}{100}$, where p = the proportion of the constituent of the gas absorbed in the first apparatus expressed in volumes per cent. The composition of the original gaseous mixture is then obtained in volumes per cent.

Manipulation of the Apparatus for Analysis by Absorption.—The measurement of the gas is effected, as described in Part I., by displacing the trapping liquid. The absorption reagent is placed in the levelling-tube B, in which all the measurements are made, inasmuch as the diminution of the volume of the gas in A is equal to the diminution of the volume of the solution in B. When the absorption is complete, the reagent is removed, and washed out, and the next absorption is proceeded with. Since the readings in B are accurate to within 0·02 per cent. of the measured volume of gas, the results are somewhat more accurate than those obtained in gas burettes. If the surrounding temperature is fairly constant, and the absorption reagent is saturated with the non-absorbed constituents of the gas, a degree of accuracy of 0·1 per cent. may be obtained.

"Recent Chemical Progress" is the title of a series of three lectures which Professor Dewar will shortly deliver at the Royal Institution.

The Gas Referees' Summer Instructions contain the usual notification that the maximum quantity of sulphur allowed in London gas is 17 grains per 100 cubic feet.

The Annual Meeting of Scottish Gas Managers.—We learn from the Convener of this meeting (Mr. J. M'Gilchrist, of Dumbarton) that it is to take place to-morrow week. Mr. J. Bell, of Dalkeith, will occupy the chair.

Institution of Civil Engineers.—At the meeting of the Institution next Tuesday, Mr. G. H. Hill, M.Inst.C.E., will read a paper on "The Thirlmere Works for the Water Supply of Manchester;" and Mr. G. F. Deacon, M.Inst.C.E., will read another on "The Vyrnwy Works for the Water Supply of Liverpool."

A New Carbide of Zirconium.—At the meeting of the Academy of Sciences on the 6th ult., MM. Moissan and Lengfeld gave an account of a second zirconium carbide (ZrC), which is distinguished from the carbides of allied metals by not reacting with water either at 0° or at 100° C.

Petroleum for Lighting Beacons and Buoys.—At a recent meeting of the Royal Dublin Society, a method of using common petroleum as the illuminant for beacons and buoys, by which a continuous light for weeks or months may be maintained day and night, without the necessity for the attendance of a light-keeper, was described by Mr. John R. Wigham.

Corrugated Water Pipes.—These are being made in India. Corrugated iron culverts from 12 inches to upwards of 24 inches in diameter have been largely used there for some time; and an Indian paper says there is a great demand for corrugated iron culverts of a smaller diameter. But it has been hitherto almost impossible to make them so small as 18 inches diameter, owing to the great difficulty in bending the sheets without injuring the material. Spirally corrugated culverts can, it is said, be made any diameter without cracking or damaging the material. Considering the small delivery through frictional and eddy losses which such pipes would have, it is curious that the form should have acquired any favour.

The Coal Production of Belgium and Germany.—According to a report from the British Legation at Brussels, lately issued by the Foreign Office, there were 120 coal mines working in Belgium in the second half of last year, as against 122 in the corresponding period of 1894. Of the total number, 66 belonged to the Mons and Charleroi coal-fields, and 54 to the coal regions of Luxemburg, Namur, and Liége. The last half-year's output in the former district was 7,369,235 tons; and in the latter, 2,791,446¾ tons—giving a total for the whole kingdom of 10,160,681¾ tons for the six months. The total output for 1895 was 20,092,412¾ tons, of which 4,573,584¾ tons were exported; France alone taking 3,561,432 tons. According to provisional returns published by the German Official Gazette, last year's total production of coal was 72,605,341 tons, against 70,644,069 tons in 1894; and of these quantities the Dortmund district alone produced 41,145,745 tons last year, as compared with 40,613,073 tons in 1894. This district does not contain any lignite, which, however, is contributed by the four remaining mine districts that also produce true coal—viz., Breslau, Halle, Clausthal, and Bonn.

TECHNICAL RECORD.

THE ACETYLENE THEORY OF LUMINOSITY.

In the "JOURNAL" for Feb. 11 last (p. 276), we published the official abstract of the paper on the above subject presented by Professor VIVIAN B. LEWES, F.I.C., F.C.S., to the Chemical Society on the 16th of January, with a report of the discussion thereon. As the paper has since appeared in the Society's Transactions, we are now in a position to place the full text before our readers.

Early in 1892, I read before the Chemical Society,* a paper in which I showed that in a luminous hydrocarbon flame the baking effect of the outer zone of intense combustion converted a very large proportion of the unsaturated hydrocarbons present in the inner zone into acetylene; the maximum production of this compound taking place just before the commencement of luminosity. In a second paper, communicated to the Royal Society in 1895,† I gave experimental reasons for considering that the acetylene so formed, on its decomposition by heat into carbon and hydrogen, was the main factor in producing luminosity, as the heat developed by this decomposition raised the carbon particles to a temperature above that of the flame.

At the time the latter paper was published, I was unaware that any other work had been done in this direction; but I find that Professors Dewar and Liveing, in their beautiful work on the spectra of carbon and its compounds, had to a great extent forestalled the conclusions to which I had arrived from a totally different standpoint. In their paper "On the Origin of the Hydrocarbon Flame Spectrum," they say, when speaking of the flame of cyanogen and acetylene:—

> Both of these compounds decompose with evolution of heat—in fact, they are explosive compounds; and the latent energy in the respective bodies is so great that, if kinetic in the separated constituents, it would raise the temperature between 3000° and 4000°. The flames of cyanogen and acetylene are peculiar in respect that the temperature of individual decomposing molecules is not dependent entirely on the temperature generated by the combustion, which is a function of the tension of dissociation of the oxidized products, carbonic acid and water. We have no means of defining with any accuracy the temperature which the particles of such a flame may reach. We know, however, that the mean temperature of the flames of carbonic oxide and hydrogen lies between 2000° and 3000°; and if to this be added that which can be reached independently by the mere decomposition of cyanogen or acetylene, then we may safely infer that the temperature of individual molecules of carbon, nitrogen, and hydrogen in the respective flames of cyanogen and acetylene may reach a temperature of from 6000° to 7000°. A previous estimate of the temperature of the positive pole in the electric arc made by one of us gave something like the same value. . . . The formation of acetylene in ordinary combustion seems to be the agent through which a very high local temperature is produced.

I extremely regret not having known of this most valuable work before; and I take this opportunity—the first afforded me—of drawing attention to it.

I also find that M. Guéguen pointed out in 1884‡ that it was very probable that luminosity in hydrocarbon flames is due exclusively to the production of rays furnished by the molecules of gas highly heated by chemical changes; and that it must be borne in mind that the heating from exterior sources would not suffice, whatever its power. He also draws attention to the fact that luminous combustion is caused by bodies which are endothermic, and from which heat is liberated during decomposition.

In November, 1895, Professor Smithells read a paper before the Chemical Society [*ante*, p. 74], in which he criticizes some of the less important points brought forward by me in my previous papers; and without attempting to disprove the fact that acetylene undergoes luminous decomposition when heated apart from air or oxygen, the principal fact upon which the acetylene theory of the luminosity of hydrocarbon flames is based, he comes to the final conclusion that, if the criticism he offers is just, "then the acetylene theory of luminosity will share the fate of the 'dense hydrocarbon' theory."

The first portion of his paper is devoted to the measurement of flame temperature by means of the Le Chatelier thermo-couple; and he comes to the conclusion that the experiments show two things: (1) The fallacious results that may be obtained by not disposing the couple with due regard to the conformation of the zone of flame to be measured. (2) The difficulty of ascertaining the increase of temperature contributed by the chemical changes occurring in any one spot. The first conclusion is self-evident; and the second I have already warmly endorsed in the paper which Professor Smithells is criticizing.

He then proceeds to explore the temperatures existing in a luminous flat flame of coal gas; using for this purpose a No. 4 Bray's union-jet burner, at a gas pressure of 2½ inches of water. As Professor Smithells considers the temperature determinations which he made as practically valueless, it is not necessary to criticize the pressure used, which should have been 7-10ths rather than 2½ inches. Considering, however, the abnormal character of the flame with which he was dealing, his figures accord fairly well with those I have given as representing the gradual rise of temperature in the inner zone of a luminous flat flame. This is of interest, as the methods employed were slightly different; and the coincidence of result goes some way towards establishing the probability of the figures.

In considering the temperature in the flat flame, Professor Smithells says: "To obtain any useful measurements for this flame, it is obvious that it can be explored in one way only—namely, by laying the junction and the adjacent wires in a horizontal straight line, and introducing it along the flat face of the flame, so that it may be placed with a considerable length of wires immersed symmetrically in any one sheath, and passing through parts of the flame in like condition." Having then taken the temperature of the outer and inner zones in this way, he proceeds to say: "The measurements for the inner parts of the flame above given have only a negative significance. It is obvious that they cannot be true temperatures, as the wires have always to be thrust through the hot outer sheath of flame; and, moreover, the couple would attain, by radiation from the outer walls, a higher temperature than the rapid stream of gas in which it is immersed."

With regard to the first objection, that the wires have to pass through the outer wall of high temperature, and that this will invalidate the reading, I think he is mistaken. There will be nearly an inch of heated wire between the thermo-couple and the point where the wires pass through the outer zone; and it seems to me that any conduction from these bodies will be more likely to take place outward along the cool wire than inwards to the heated zone, so that if an equal length of wire on each side of the weld is heated in order to prevent unequal resistances being introduced, the readings should not suffer much from this cause.

Nor does his second objection appear to me to be in any way a fatal one. If the gases in the inner zone had to pass through a circle or even a belt of high temperature, the objection would be valid; but, inasmuch as the gases are flowing up within a sheath of high temperature which exists even after the inner zone ceases to exist, and which is fairly constant in temperature, these gases will probably be as much exposed to radiation as the thermo-couple.

In taking such readings, the thermo-couple is only exposed in the heated zone for a very short period. It has been pointed out by Le Chatelier that the couple takes up with astonishing rapidity the temperature of the locality in which it is placed; while Mr. Callendar has pointed out that a spiral of platinum wire is a bad radiator, and is exceedingly sensitive to slight changes in temperature. It may be assumed, therefore, that it will not absorb radiant heat with great rapidity, and that the temperatures recorded in the non-luminous zone are not far removed from the truth.

Professor Smithells further accentuates his distrust of these recorded temperatures by saying "the readings are not even comparable, as the flame varies in breadth and thickness from point to point in a vertical plane." The inner zone undoubtedly becomes narrower in the higher regions of the flame, until ultimately the outer walls meet at the top of the flame. But the rise of temperature due to this cause is one of the factors that aid the generation of light in a flame; and if a gas were flowing up a gradually narrowing tube, heated throughout to an even temperature, it would manifestly become hotter the nearer the walls of the tube approached each other. I cannot understand why, because the thermo-couple records this fact, the readings are to be discredited.

In the determinations I made of the temperatures existing in the flame of a No. 6 Bray union-jet burner, I did not attempt to take the temperature of the outer zone, as it was manifest that this would be the hottest part of the flame. I felt that it would be hopeless to get any accurate readings of it, as it seems clear that close to the inner zone, where there is the maximum of combustible gas meeting with oxygen for its combustion, there will be the hottest part of the flame, while the admixture of nitrogen, air, and the escaping products of combustion will cause a rapid fall in temperature to the outer portion of this zone, which extends much farther than mere observation of the flame would lead one to expect; and that in the outer envelope there are so many graduations of temperature, from the hottest to the coolest portion where combustion is finally extinguished, that it would be impossible to obtain even a general idea of its temperature. The main point I wished to ascertain was the effect this high temperature layer of combustion had on the gases flowing up through the inner zone.

The question of passing the wires of the thermo-couple through this heated layer before the inner zone could be reached, of course presented itself at the commencement of the experiments; and, after trying several methods, including the one adopted by Professor Smithells, I came to the conclusion that the best way of doing it was to make the twist of the thermo-couple very short, and to bend each wire at right angles three-quarters of an inch on each side of the couple, so that on plunging it into the flame an equal length of wire on each side of the twist was equally heated, while the portions of the wire passing through the more highly-heated zones were equi-distant from the couple—thus ensuring no unequal resistances being introduced.

In my later experiments, I have employed a fixed stand for the

* See "JOURNAL," Vol. LIX., p. 795. † *Ibid.*, Vol. LXV., p. 796.
‡ Transactions of the Société Technique de l'Industrie du Gaz en France, 1884, p. 142.

burner and the thermo-couple, so that the exact position of the couple could be accurately determined. In this case the wires come out at the side of the flame, as in Professor Smithells' experiments; but the thermo-couple being fixed immediately over the centre of the burner, an equal length of wire is heated on each side of the couple.

The use of the Le Chatelier thermo-couple for the determination of high temperatures is now becoming so general, that a description of the precautions necessary in using it will not be out of place; and in my later experiments these were employed. The thermo-couple was connected in series with a dead-beat galvanometer—Ayrton and Matthers' pattern—having a resistance of 304 ohms; and in order to bring the deflections for the high temperatures within the limits of the scale, a further resistance of 309 ohms was included in the circuit.

The galvanometer was calibrated by means of a cell of small internal resistance and a box of high-resistance coils; and, on plotting out the currents and deflections, a straight line was obtained—showing that within the limits of the scale the deflections were directly proportional to the currents. The platinum and platinum-rhodium wires used for the thermo-couple were 0·011 inch, or 0·279 mm., in diameter, which is the thinnest that can be used without fear of fusion at the highest temperature of the flame. The resistance of the platinum wire per metre was 1·71 ohms; that of the platinum-rhodium wire being 3·6 ohms. In the experiments described by Professor Smithells, the total resistance of wire and galvanometer was about 4 ohms, which enormously increases the risk of error.

The galvanometer and lamp being fixed on a stand, so as to give no possibility of displacement, the couple and galvanometer were calibrated for temperature; the fixed points selected being the following:—

	Deg. C.
Boiling-point of sulphur	444·5
Melting-point of pure silver	945·0
" " copper	1045·0
" " palladium	1500·0
" " platinum	1775·0

The melting-points of the compounds of the alkalies and alkaline earths vary so widely, as determined by different observers, that they are practically useless for this purpose; and, as there seemed to be some doubt as to whether the E.M.F. of the thermo-couple is directly proportional to temperatures above 1000°, I made thirteen determinations of the fusing-point of palladium, and sixteen of platinum. On plotting out a curve for the temperatures, I obtained a straight line for all except the palladium, which was above the line. L. Holborn and W. Wein find the melting-point of palladium to be 1587° C.; and had this figure been taken, it would have been close to the same line as the others. From this, I think it is safe to assume the course of the curve continues in a straight line above 1000° C.

In continuing his paper, Professor Smithells proceeds to criticize the values which he obtained for the outer envelope of the flame; and by testing this portion with a thin platinum wire, which he heats to fusion, he comes to the conclusion that his results give a temperature slope opposite to that given by the thermo-couple—*i.e.*, that the hottest portion of the outer envelope of the flame is near the bottom. He explains this as being caused by variations in the thickness of the outer sheath of combustion.

In supposing that this is so, I think Professor Smithells is right as to his facts, but wrong as to the causes to which he ascribes them, as the combustion which gives the outer envelope to the flame in the lower half is mainly due to marsh gas and hydrogen diffusing out from the gas itself; while in the upper portion of the flame it is due to carbon monoxide and hydrogen produced by the actions in the flame—the combustible gases being diluted by the products of the actions taking place. One would expect, therefore, that the lower portion of the non-luminous envelope would be hotter than the upper, although, in point of fact, the temperature differs but little, as the accumulation of heat from the combustion going on in the lower part of the flame tends to increase the temperature of the upper portion.

I am in entire accord with Professor Smithells' conclusion that "there are two separate heat-gradients in a luminous coal-gas flame—one on the vertical axis, which is, in all probability, a steady decline from the top to the bottom; the second on a horizontal axis, showing, as we proceed from the centre of the unburnt gas, a steep ascent to the point of contact with the luminous sheath, then a still steeper ascent to the point of contact with the mantle, where the highest point is abruptly attained." That the temperature gradient on the vertical axis is a steady decline from top to bottom, is perfectly clear from both our experiments; while that there is a second gradient in a horizontal axis, with the coolest point in the centre of the flame (which is at the greatest distance from the source of heat), is, I think, a foregone conclusion, and I cannot conceive any other condition.

The second conclusion is that the temperature of the mantle of a coal-gas flame is above the melting-point of platinum, and cannot, therefore, be determined by a thermo-couple in which platinum is one of the elements. Professor Smithells' own experiments show that his thermo-couple registered a temperature there of 1478° at the bottom of the sheath to 1613° at the top of the flame; and thus his assumption that the temperature exceeds that necessary for melting platinum, is dependent on the melting in the outer mantle of very fine platinum wire.

In my previous paper, I have shown the influence which the thickness of the platinum and platinum-rhodium wire used has on the temperature recorded; and I have clearly pointed out that, in all the experiments quoted in that paper, wires having a diameter of 0·011 inch, or 0·279 mm., were employed. Professor Smithells uses wires of nearly double this thickness, and obtains a recorded temperature of 1838° before his couple fuses. This, if corrected to the thickness of wire I employed, would be over 2000°. This is caused by the larger cross section of the wire, which is in the ratio of 3·2 : 1, which would lead to a proportionately larger amount of heat being lost by conduction. I found that during the determinations of the deflections corresponding to the fusion of platinum, great care had to be exercised in raising the temperature of the junction exactly to the melting-point. It was, in all cases, the platinum of the junction which fused first; and in some cases the platinum-rhodium wire was surrounded by a film of melted platinum. It was easy, by carefully heating the junction with a small oxyhydrogen flame, to obtain readings far above the mean obtained for the melting-point of platinum; showing that, although the platinum was in the liquid state, a thermo-current was obtained of greater strength than at the temperature of the simple fusion of platinum.

Professor Smithells makes a strong point of the fact that luminosity does not commence suddenly at a certain height, but appears as an envelope just below the inner surface of the outer zone, while the non-luminous zone continues inside the luminous zone to a considerable height in the flame. This manifestly must be so, as the decomposition of the diluted acetylene only takes place as particles stray close to the point where the highest temperatures exist; and as the centre of the inner zone is below the necessary temperature, the decomposition of this compound only takes place close to the point where the two zones coalesce. If flames of various illuminating powers are examined, it will be noticed that the greater the light emitted—that is, the richer the flame is in acetylene—the more marked is the commencement of luminosity; so that, although the luminosity begins as a yellow haze with a poor coal-gas flame, it commences almost as a sharp line with a rich acetylene flame.

In concluding this portion of his paper, and in order to show the untrustworthy nature of the temperatures thus recorded, Professor Smithells takes two sets of the determinations of temperature existing in flat flames, made at periods three years apart—the one with coal gas burning from a No. 0000 Bray, the other from a No. 6 Bray; and he feels surprised that they do not show "parallelism." The temperatures given are—

	No. 0000 Bray.	No. 6 Bray.
Non-luminous zone	1023°	1014°
Commencement of luminosity	1658	1267
Top luminous zone	2115	1368
Luminosity	practically nil.	About 13 candles.

When a flame of coal gas is spread out in an extremely fine sheet, as when burning from a No. 0000 Bray, the amount of air required for the complete combustion of the gas is much more quickly obtained, luminosity is considerably reduced, and a far higher temperature is attained; while the commencement of the feeble band of luminosity is also thrown far nearer the top of the flame, and must therefore be at a higher temperature. Had there been what Professor Smithells is pleased to call "parallelism," it would have given good grounds for suspecting the worthlessness of the determinations. Moreover, a thicker wire was used in the determinations taken with the No. 6 Bray in 1892; and I have fully indicated the result of this.

An effective point is made by pointing out that one of these temperatures is 330° above the melting point of platinum, as determined by Violle. In any determination of the temperature of the luminous zone, the reading has to be taken with the greatest rapidity, as otherwise the formation of carbon on the couple causes a falling off in the temperature recorded. In the case instanced, the spot of light rapidly rose to the division which had been calibrated as 2116°, and then fell with great oscillations. On removing the soot from the couple after cooling, it was found that the wires were welded together, and the platinum fused over the surface of the platinum-rhodium; the couple having evidently been only just saved from complete fusion by the deposition of the carbon.

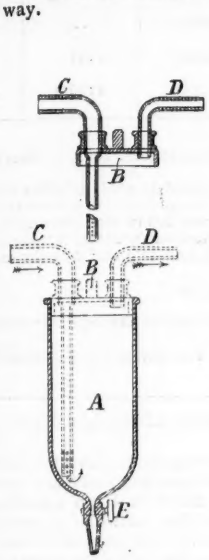
The thermo-couple records with great rapidity the temperature attained by the outer surface of the metals; and it by no means follows that the moment needed to do this should be sufficient to raise the whole mass of metal to the melting-point. In my last paper, several temperatures of between 1800° and 1900° are recorded; and Professor Smithells fails to call attention to these, I presume, because he found in his own experiments, using wire of nearly double the thickness, that the couple recorded 1836° before fusion of the platinum in a hydrogen flame; while had he employed an oxyhydrogen flame, so as to very rapidly heat the couple, he would have found it easy to obtain still higher readings. I can only again repeat the statement made in my previous paper, that although flame temperatures taken by the Le Chatelier thermo-couple may be totally incorrect, they are, at any rate, comparable when proper precautions are taken in the methods of using the couple.

(*To be continued.*)

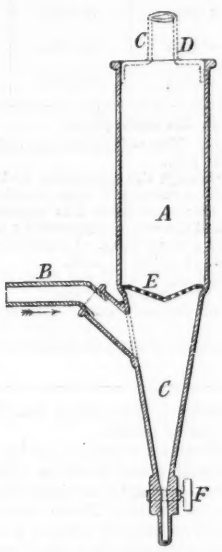
WINSTANLEY'S AMMONIA SATURATOR AND SULPHUR CONDENSER.

In the accompanying illustrations are shown an ammonia saturator and a sulphur condenser devised and patented by Mr. F. A. Winstanley, for which special advantages are claimed.

The ammonia saturator consists of a glass vessel A, filled with glass beads; a stopper B, with removable inlet and outlet tubes C D; and drain-tap E. In order to set the apparatus at work, the saturator is charged with dilute sulphuric acid in the usual way, after closing the drain-tap E; the inlet C is then connected with the gas, and the outlet D with the meter. To estimate the amount of ammonia in the gas, after the usual quantity of gas has passed through the saturator, the stopper B is removed, and the drain-tap E opened; then a quantity of distilled water is poured in at the top of the vessel, and the liquid allowed to drain out as much as possible into a beaker. After this operation, the analyses may be proceeded with in the usual way.



Ammonia Saturator.



Sulphur Condenser.

A few of the advantages claimed for this apparatus over the Referees' form of saturator are the following: (1) Greater accuracy in the estimation of the ammonia in the gas, since the gas must pass through the acid in the saturator before it can find an outlet. In the Referees' form, the gas has a tendency to pass over the acid, thus going away without the ammonia being arrested, owing to the acid lying in the bottom of the saturator. (2) Easy access to the beads; it being only necessary to take out the stopper to remove the beads. (3) Greater facility and accuracy in washing out than is the case in the Referees' apparatus. (4) Greater convenience, as the saturator need not be removed from the stand when washing out.

The sulphur condenser consists principally of a glass cylinder A, which is filled with small glass balls, having a perforated tray E for the balls to rest upon; a reservoir C, for the reception of the condensed liquid; an inlet-tube B; a removable outlet-tube D; and a drain-tap F. The method of setting the apparatus to work is similar to that employed with the Referees' test; but with the following advantages, among others, over their condenser: (1) Greater accuracy in the estimation of the sulphur compounds in the gas. Owing to the reservoir for the condensed liquid being made in one piece with the condenser, the reservoir is rendered air-tight; and therefore deterioration of the liquid by contact with the atmosphere is prevented. (2) The condenser is more easily and conveniently washed out than is the Referees' form. (3) No loss of washings is experienced. Owing to the inlet B being made on an incline, no inconvenience is caused through the liquid escaping through the inlet, as is the case in the Referees' form of apparatus; thus necessitating some means of stopping up the inlet during the process of washing out. (4) No india-rubber connections are needed (their use is purely optional), as the inlet and outlet tubes are ground so as to obviate the necessity for rubber connections. (5) None of the washings are left in the condenser, as is the case in the Referees' apparatus. Hence, again, greater accuracy is ensured in after-analysis.

Society of Engineers.—At the meeting of this Society next Monday, Mr. Percy Griffith, Assoc.M.Inst.C.E., M.Inst.M.E., will read a paper on "The Water Supply of Small Towns and Rural Districts." Mr. Griffith is specially qualified to deal with the subject he has chosen, having been for some years professionally associated with the late Mr. Jabez Church, whose practice was to a large extent connected with water engineering. Mr. Griffith is a member of the Council of the Society.

RESEARCHES ON THE COMBUSTION OF ILLUMINATING GAS IN COOLED FLAMES AND GAS MOTORS.

(*Continued from p.* 623.)

IV.—Researches on Combustion in Gas Motors.

A.—*The Gas Motors Tried, and the Collection of the Gas.*

Two Otto gas-engines from the Deutz works were available. One was a 4-horse power motor of the old pattern, with flame ignition; and the other was a 2-horse power valve-motion modern motor, of the E V type, with hot-tube ignition. The slide-valve motor had the following dimensions: Diameter of piston, 0·171 metre (6·73 inches); stroke, 0·340 metre (13·39 inches); piston space in cylinder, 7·808 litres (476·5 cubic inches); compression space, 4·85 litres (296 cubic inches). Working at 4 brake horse power, this motor gave the following heat-balance account: Heat received = 4735·5 calories. Heat expended: In indicated work, 777 calories (in brake load, 636 calories); in the cooling water, 2400 calories; and in the exhaust gases (?), 1558·5 calories.

The following table gives the indicated horse power and consumption for certain loads:—

Brake Horse Power.		Indicated Horse Power.		Consumption in Cubic Feet per Hour.
1·187	..	2·61	..	74·15
2·150	..	3·41	..	88·42
3·065	..	3·97	..	110·50
3·960	..	4·84	..	132·08
0·000	..	1·42	..	46·62

The brake horse power of the lift-valve regulated motor was determined at two different positions of the gas-inlet cock; and the following figures were found: Position of cock, 10; brake load, 25·09 lbs.; number of revolutions, 238; diameter of fly-wheel, 4½ feet; horse power, 2·6. Position of cock, 5; brake load, 14·22 lbs.; horse power, 1·5.

In the experiments with the slide-valve motor, it was loaded with a firmly attached brake, regulated so that the gas-inlet valve opened in one series at every second revolution, and in the other series at the 1st, 3rd, 9th, 11th, 17th, 19th, 25th, 27th, &c., revolutions. The first case is that of normal running, when an explosion occurs at every fourth stroke. The second entailed 16 strokes to complete the cycle of operations; but occasionally this was not maintained, and the cycle was completed in fewer or more strokes, according to which stroke was missed.

The lift-valve motor was also examined under full and reduced load. In this case, however, with the small load the explosions were not missed, because the gas-valve was only partially opened, and the motor thus received a charge at every fourth stroke in both series of trials; but in the one the mixture was rich, and in the other poor in gas. The motor was coupled to a dynamo and accumulator battery. At the highest, the motor gave 1200 watts; but after prolonged use, it gave only 1000 watts. The motors were reserved almost entirely for the experiments during the period of their continuance.

Cylinder lubrication was carried out in the slide-valve motor by means of a fatty oil, which had a viscosity by Engler's instrument of 20 min. 44 sec. at 20° C. About 2 per cent. of this oil distilled over under 340° C. (644° Fahr.), and 60 per cent. under 370° C. (698° Fahr.) The lubrication of the lift-valve motor was carried out with a mixture of pure bright Baku oil and Nobel petroleum, having a viscosity of 236 to 239 seconds at 20° C. To avoid as far as possible combustion of the lubricating oil, lubrication of the well-fitting inlet-valve was discontinued during the experiment.

The spent gas was collected from a cock placed in the exhaust-pipe, from 20 to 40 inches from the exhaust-valve. It was drawn from the cock through a short piece of flexible tubing, into an aspirator of about 1¼ cubic feet capacity; the water expelled being measured. With the motor running under full load, the gas was rich in carbonic acid; and after measurement, it was diluted with half its volume of air free from carbonic acid. Under a light load, the exhaust gas was poorer in carbonic acid, and dilution was unnecessary. The gas was drawn from the collecting vessel through the absorption apparatus; and at the end of the test the volume of the gaseous residue was ascertained. Compared with the collection of gas described in the last section, there is here an important difference, as the carbonic acid in the gas collected diminishes owing to its solubility in water. In earlier experiments, its partial pressure was low; and the combustible gases—carbonic oxide, hydrogen, and methane—are comparatively insoluble. The solubility of acetylene would be responsible for considerable loss; but this gas occurred only in traces. Therefore the proportion of combustible gases to the carbonic acid found by weighing appears too great; but owing to their not being quite insoluble, the proportion to the volume of carbonic acid found volumetrically at the beginning of the experiment is too low. The quantity of carbonic acid found gravimetrically is about four-fifths of the amount found in the gas at the commencement volumetrically. It may be pointed out here that the volumetric determination of the exhaust gases is not very exact, as the gas, even if no explosions are missed, is not a homogeneous mixture; and the deficiency of oxygen shown by the analyses quoted by Slaby is attributable to this fact.

TABLE III.

B.—*Results of Gravimetric Analyses with Complete Combustion.*

	Position of Cock.	Load.	Temperature of Cooling Water.*	Rate of Feed, in Cubic Centimetres per Minute.	Grammes of Carbonic Acid before Combustion Tube.	Grammes of Carbonic Acid (Col. 6) and Water (Col. 7) after Combustion Tube.		Ratio of Atoms Carbon : Hydrogen.	Degree of Incompleteness.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(9)	(10)
Experiments with the Lift-Valve Motor.	(*a*) 10	1200 Watt (maximum)	65°–66° C. (149°–151° F.)	580	2·9585	0·0124	0·0106	—	0·42
	(*b*) 10	,,	60°–66° C. (140°–151° F.)	740 to 690	2·3226	0·0129	0·0152	—	0·55
	(*c*) 5	590 Watt	48°–58° C. (118°–136° F.)	660 to 610	1·7150	0·0723	0·0448	1 : 3·03	4·39
	(*d*) 5	545 ,,	63°–64° C. (145°–147° F.)	545 to 530	1·9095	0·0648	0·0775	1 : 5·85	3·28
	(*e*) 10	1150 ,,	23° C. (73·5° F.)	400	2·0191	0·0107	0·0095	—	0·53
Experiments with the Slide-Valve Motor.	(*f*) Four strokes to complete cycle	..	..	..	2·1326	0·0046	0·0089	..	0·22
	(*g*) Do. do.	..	..	..	1·4079	0·0048	0·0066	..	0·34
	(*h*) Sixteen strokes to complete cycle	..	80° C. (176° F.)	900 to 960	0·5559	0·0089	0·0324	1 : 18	1·58
	(*i*) Do. do.	..	..	..	1·6863	0·0226	0·0757	1 : 16·4	1·32

* Taken by means of a thermometer in the outlet-pipe.

(*a*) A sample of gas taken from the exhaust contained 8·4 per cent. of carbonic acid. The volume of gas aspirated amounted to 17·43 litres; and the percentage of carbonic acid calculated from this volume and column 5 is 8·63.

(*b*) A sample of the exhaust gas diluted with about half its volume of air was led through the apparatus, and was found to contain before dilution 8·66 per cent. of carbonic acid. The test lasted fifteen hours. The gaseous residue contained, when undiluted, 6·02 per cent. of carbonic acid.

(*c*) A sample of the exhaust gas was diluted with about one-third its volume of air; and from this mixture it was found that the original gas contained 5·05 per cent. of carbonic acid. From the volume of gas consumed and the weight in column 5 the calculated percentage was 4·05.

(*d*) Samples taken in the burette before and after the aspiration test showed 4·5 and 4·1 per cent. of carbonic acid, and 11·9 and 13·2 per cent. of oxygen. The aspiration test calculated from column 5 showed 3·52 per cent. of carbonic acid.

(*e*) Burette samples taken as in (*d*) gave 10·0 and 10·7 per cent. of carbonic acid, and 4·5 and 2·6 per cent. of oxygen.

(*f*) A burette sample from the exhaust gave 10·1 per cent. of carbonic acid and 3·5 per cent. of oxygen.

(*h*) Four burette samples from the exhaust showed 4·1, 3·2, 4·2, and 3·8 per cent. of carbonic acid. The residual gas in the aspirator contained 2·9 per cent. of carbonic acid and 13·4 per cent. of oxygen.

A burette sample from the exhaust gave 3·7 per cent. of carbonic acid; the aspirator sample, 3·9 per cent. The percentage calculated from the volume aspirated and column 5 was 3·69.

From these experiments, it is clear that only traces of combustible gases escape when the engines are running under full load, but that appreciable quantities do so when they are running under half load. Incomplete combustion of the lubricating oil cannot account for this difference in the amounts found under the two conditions. Thus, under full load, 10 litres of the exhaust gas yield on combustion, on the average, 0·0082 gramme of carbonic acid and 0·0086 gramme of water; and under half load, 0·0284 gramme of carbonic acid and 0·0245 gramme of water. But the quantities of combustible gas formed by the decomposition of the lubricating oil would be greater under full load, owing to the higher temperature and lower percentage of oxygen in the cylinder under this condition. A study of the contraction on explosion of the mixture of gas and air under full and half load, also shows that the combustible gases remaining must be ascribed to incomplete combustion of the coal gas.

The ratio of the atoms carbon to hydrogen in the lift-valve motor, points to methane and hydrogen as combustible constituents; but this ratio diminishes greatly, and hydrogen must preponderate in the slide-valve motor. When, however, the moment of ignition was carefully controlled in the lift-valve motor, the ratio became precisely that found with the slide-valve one. In order to have a continuous check on the working of the motors, and to ascertain that the ignition of each charge actually took place, and no unignited charge was expelled in the exhaust gases, an electrical contact apparatus was arranged to register the charges from a lever on the gas-inlet valve, and the explosions from the pointer of an indicator. Both motors were tried under different conditions with this registering apparatus attached; and it was found that the explosion did not once fail in 1000 revolutions.

C.—*Qualitative Analysis of the Combustible Constituents.*

Hydrogen was sought for by Phillips's method. The reaction occurred very sharply, and much more vigorously than with the bunsen flame spent gases. Carbonic oxide was sought for by experiments on mice, as Hempel has suggested. A mouse was enclosed in a tubulated flask, into which the exhaust gas, freed from carbonic acid, was passed by the lower orifice, and led off from the neck to a meter, where its volume was measured. In one experiment, with the motor yielding 500 watts, 33 litres of the exhaust gases, freed from carbonic acid, were passed through the flask in 90 minutes; and the gas issuing therefrom was found to contain 0·3 to 0·4 per cent. of carbonic acid and 12·3 to 12·1 per cent. of oxygen. After the lapse of an hour, the symptoms of poisoning had so far developed that the animal moved with difficulty, and was subject to convulsions. It was killed by immersion in water; and its blood was examined spectroscopically alongside that of a freshly killed mouse. On treatment with colourless ammonium sulphide, the blood showed the red colouration indicative of the presence of carbonic oxide; and under the spectroscope, the lines were unmistakably clear. In a second experiment, with the motor running to a load of 410 watts, 94½ litres of gas were passed through the flask in 105 minutes. The animal was a more robust one than that used in the first experiment, and exhibited much less decided symptoms of poisoning; but the tests of the blood gave precisely similar results.

Acetylene was sought for by drawing more than 150 litres of the exhaust gases through tubes containing soda and potash, and then through washing flasks filled with an ammoniacal solution of silver. From two tests, the quantity of acetylene was found to be only 0·0003 per cent. of the gas; and therefore no further quantitative tests were made. Olefines were sought for by absorbing the oxygen present with phosphorus, and observing if absorption took place naturally. [The method has been described in Section III.] The test, like those already described in this sub-section, was made on the exhaust gases of the lift-valve motor; and there was no indication of the presence of olefines. No special qualitative tests were made with the slide-valve motor; but the presence of carbonic oxide and hydrogen in the exhaust gases was proved in the course of the experiments on fractional combustion.

(*To be continued.*)

THE RECOVERY OF TAR AND AMMONIA FROM BLAST-FURNACE GASES.

At the last Meeting of the Institution of Engineers and Shipbuilders in Scotland, Mr. A. GILLESPIE, of Glasgow, read a paper "On the Recovery of Tar and Ammonia from Blast-Furnace Gases," with which branch of the gas industry he has had a large amount of experience. It was as follows:—

Though coal tar as a distillate from coal was known for more than a century before 1798—having made its appearance in connection with various attempts to produce coke for smelting purposes—it was not until about that time, when William Murdoch made his discovery of illuminating gas from the destructive distillation of coal, that tar as a product was made in such quantities as to demand separate attention. At first it was got rid of as a "nuisance," and ultimately it was found to have such distinct values of its own as to remove from it the reproach of bye-product, and bring it into line with original processes. As to the "nuisance," it may be said that within living memory it seemed practically impossible to get rid of the tar; and as to value, coal tar now counts upwards of fifty constituents of separate commercial importance.

As this fact came to be realized, together with the growing necessity for economizing fuel, attention was directed to the waste of the gases seen burning at the top of blast-furnaces. Until comparatively recent years, it was considered that the coal charged into a blast-furnace had done its whole work when the ore was smelted and the liberated iron run into "pigs;" the air of the hot blast being heated by additional coal in a separate stove. The first step in the utilization of the waste gases was in closing the furnace tops, and passing the gases so confined by a system of piping to the boilers for supplying steam to the blowing-engines and to the air-stoves for heating the blast. This was a clear saving of all the coal outside the

furnaces. The next step was taken when it became evident that the tar which revealed itself in the "green" gas coming from the closed furnace top, causing trouble and discomfort in the combustion of the gases, might be turned to advantage, as had been done in the production of illuminating gas.

The initial difficulty in the treatment of such gases lies in their enormous volume. The quantity of gas obtained from a ton of coal distilled in ordinary retorts for illuminating purposes is about 10,000 cubic feet; while from the presence of the air-blast mixing with the coal gas distilled in the process of smelting the volume is increased to about 130,000 cubic feet, or thirteen times the quantity of illuminating gas. The valuable bye-products which come from the coal alone are thus diffused through the entire volume; while to recover them it is necessary to deal with the whole. To give some concrete comparison of such a large volume, it may be stated that the greatest output of gas from the whole of the Corporation gas-works in the Glasgow district is less than 30 million cubic feet per 24 hours; while the volume coming from four blast-furnaces is upwards of 40 million cubic feet, requiring a collecting-main having a diameter of 8 feet. Next in order is the difficulty which is involved in the high heat of the gases that pass by the collecting-main to the recovery plant; the temperature being about 300° Fahr., which must be reduced to less than 70° before ammonia can be properly recovered—the tar being in the meantime obtained in the process between those limits of temperature. It thus becomes apparent that the apparatus must be on a very large scale; while the difficulty and expense are increased by the fact that the combined gases form an approximately explosive mixture—rendering it necessary to make ample provision against possible danger.

The first attempt to recover the tar and ammonia from blast-furnace gases was carried out about sixteen years ago by Messrs. M'Cosh and Alexander, of the Gartsherrie Iron-Works, and known as the Gartsherrie process. Other methods followed, all more or less based on the ordinary process of removing the tar and ammonia from illuminating gas (differing chiefly in dimensions); and now nearly all the active blast-furnaces in Scotland have been furnished with a recovery plant of one form or another. As yet scarcely any of the iron-smelting furnaces in England are so equipped; the smelting done in them being chiefly effected by coke, instead of by raw coal. In a few cases, the products have been extracted from the ovens in which coke is prepared; but, as a rule, the product-bearing gases are neglected and lost by combustion in the coke-oven.

It might be supposed that, while the recovery of the ammonia from the blast-furnace gas does not reduce the calorific value, the extraction of the tar compounds would have such a result. But practically this has not been found to be the case, for the clean gas after the recovery process is in better condition for burning under the steam-boilers and in the hot-air stoves than when it was laden with tar and dust; and it is clearly proved that from the same coal charged into the furnace, or, more accurately, from the surplus gases generated from the coal in combustion, is derived heat-energy sufficient to drive the blowing-engines and heat the air of the blast to 1700° Fahr., *plus* the oil, the pitch, and the sulphate of ammonia obtained in the recovery plant. To put this again into concrete form, it may be stated that the results obtained from a plant recently erected in connection with four furnaces show that, in addition to the usual output of pig-iron, the clean gas raises steam in seventeen large high-pressure boilers, heats the air in three regenerative stoves, distils the tar into oil and pitch, and evaporates the waste liquor; while the recovered tar yields 7 gallons of oil and 86 lbs. of pitch, and the ammoniacal liquor 25½ lbs. of sulphate of ammonia per ton of coal put into the furnaces. The total recovery for 1895 from 92,940 tons of coal carbonized in the four furnaces amounted to 677,000 gallons of oil, 3550 tons of pitch, and 1057 tons of sulphate.

As we are not concerned with the gases in combustion in the "boshes" or hottest part of the blast-furnace, where the ore is being reduced, but with those from between the "burden" of raw coal and iron ore and the closed top, which we may term the surplus or "green" gases, these, prevented from access to the air and consequent ignition, pass by the open valve of the down-comer tube from each furnace to the collecting-main. The green gas is drawn through this main by exhausters placed farther on in the plant; and the high temperature is conserved as far as possible by a fire-brick lining inside the main. It then enters the first vessel in the process—the "tar-washer"—which is a large, oblong-shaped tank having the bottom ridged and sloping to each end. Internally there are two compartments which are formed by longitudinal partitions to give a double wash. These partitions are fitted with serpentine diaphragms having serrated edges. When in operation, the compartments are charged with tar till it rises above, or seals, the edges of the diaphragms; thus rendering it impossible for the gas to pass except by washing through the tar. The gas is drawn through the seal by the power of the vacuum which is formed by the exhausters; and the entire area is continuously agitated, with a double result. First, the hot gases partially distil the water out of the tar; secondly, the contact with the tar in the washer entangles the tar particles in the gas, and precipitates them on the sloping bottom, whence the heavier tars are run off at intervals to the stock-tank. Along with the heavier tars, the gas has lost in this washer about 130° of its heat, and is ready for the final cooling in the "condenser." This vessel is divided into eight sections, each having a separate chest fitted with eighteen pairs of pipes which are 20 inches in diameter and 54 feet high. An arrangement is made in the chest so that the gas passes up one pair and down the next continuously, till by the time it reaches the final pair its exposure to the atmosphere reduces the temperature to 70° and less. In warm weather, it is necessary to supplement this cooling by a spray of water on the top of each pipe. The water runs down the outer surface, both reducing and equalizing the temperature.

The lighter tars and weak ammoniacal liquor which are separated from the gas in condensing are collected from each section, and pass into a "separator," where, by the difference in their specific gravities, the tar and liquor are automatically separated. The gas now passes by double branches into the first "liquor-washer." This is a vessel 60 feet long, 12 ft. 6 in. wide, and 7 feet high. It is fitted internally with a longitudinal partition and serpentine diaphragms, similar to those of the tar-washer, but with a wider single action. They are sealed in weak liquor; and the gas, now at a temperature of about 60°, is again drawn through the seal by the exhausters—the diaphragms dividing the gas into thin streams. In the continuous agitation caused by the displacement, the light tars are washed out, and the ammonia is taken up by the liquor. The products pass by a regulating valve into another separator; while the liquor, at a strength of 1¼° Twaddell, is run into a stock-tank for treatment in the sulphate-stills, and the light tar to feed the tar-washer.

Next in order in the process come the exhausters, which are of various forms. There are three of the ordinary Root's blower type, each capable of passing 900,000 cubic feet of gas per hour. As the effective washing of the gas depends on the depth of seal in the washer, the vacuum necessary to draw the gas forward is regulated for each vessel by tubes connected from them to gauges placed in the exhauster-house, so that the attendant may control the speed as required.

The second and final liquor-washer is placed beyond the exhausters, and is the same in all respects as the first, except that the gas is forced through the seal, and the vessel is fed with clean cold water. In this washer, the last traces of tar and ammonia are received; and the gas is cleaned ready for use at the boilers and air-stoves, to which it passes in a pipe having a diameter of 5 feet. The products—consisting of weak ammoniacal liquor, of about 0·5° Twaddell strength, and light frothy tar—are again separated, the liquor returned to feed the first liquor-washer, and the tar as before to the tar-washer.

In the further treatment of the recovered products, the heavy tars, run periodically from the bottom of the tar-washer into the underground stock-tank, are run as required into blowers, and delivered by compressed air into an elevated charging-tank near the tar-stills, into which the tar gravitates for distillation. These stills are waggon-shaped boilers formed with double-flue recesses on the bottom, and fired by the clean gas. Each still is supplied with a worm condenser placed in a cold-water tank.

When a still is charged, and the gas turned on and ignited, the first portion of the distillate is water. The tar as at first recovered from the furnace carries about 80 per cent. of water; but this has been reduced, as has been seen, by exposure to the hot gases in the tar-washer. When the water has been driven off, a light oil begins to appear; getting heavier as the distillate approaches the pitch stage. The distillate running from the worm passes into a separator; and the water, containing traces of ammonia, is cooled and sent back to feed the first liquor-washer, while the oil passes into the blowers, from which it is delivered, by compressed air, into the oil stock-tank, or into barrels for immediate sale. When the still is ready for "pitching," the worm is shut off, and the liquid pitch run first into a cylindrical cooler, and afterwards into open ponds, to harden solid, and is then broken up, packed, and despatched.

The ammoniacal liquor stored in the liquor division of the stock-tank is run into blowers, and delivered into an elevated tank, as described for the tar, whence it gravitates continuously into the sulphate-stills. In the sulphate-house there are two vertical cylindrical stills, each fitted internally with eleven horizontal trays, having open nozzles projecting upwards, placed as close together as possible, and each nozzle covered by a loose cup having serrated edges. The ammoniacal liquor is run in upon the top tray, filling all the space round the nozzles, and sealing the cups. It is compelled, by means of a baffle-plate, to circulate round the nozzles; while at a certain level it runs off by a pipe to the next lower tray—the process being repeated from tray to tray till the bottom is reached. At that point, steam is introduced under the bottom tray, and, passing up by the open nozzles, it bubbles out through the serrations of the cups; and the steam, ascending through the nozzles from tray to tray, meets the descending liquor, and, by the inducement of greater affinity, robs it of its ammonia—carrying it off at the top in the form of ammoniacal vapours. These are conveyed by a system of piping into the saturator—a lead-lined vessel charged with sulphuric acid. The vapours are taken right to the bottom through a lead "cracker" pipe, which is perforated with small holes through which the vapours pass and combine with the acid, forming sulphate of ammonia, which contains 24 per cent. of pure ammonia. After boiling for some time, crystals of the salt are precipitated in the bottom of the

saturator, from which they are fished out by hand ladles or mechanical dischargers, placed in skips over a draining-table, and, when dry, conveyed by an overhead rail to the sulphate-store for packing and despatch.

So far, we have been recovering saleable products from what was formerly "waste and nuisance." But it cannot be said we have entirely removed the waste or the nuisance. The waste or surplus gas not required for any heating purpose is automatically passed into the atmosphere when the quantity exceeds the pressure required; the escaping gas being burned as it passes into the air. The waste vapours coming from the saturator may be condensed and purified before passing into the air, or destroyed in the still flues and chimney. But the waste or effluent liquor coming from the sulphate-still is not so easily got rid of; and the efforts to dispose of it remind one of the tar nuisance of former days. Even after filtration, it is not safe to run into a stream. It seems to be fatal to fish; at least they do not thrive on it.

At the works referred to in this paper, the form of still adopted removes nearly all the solid from the liquor. The stills, which are fitted with appliances for ease and rapidity in cleaning, are opened at intervals, and the cups and nozzles are cleaned of the pitch deposit; while the liquor as it leaves the bottom of the still passes into a large settling-tank, through which the current travels slowly against baffle-plates—throwing down any solids contained in the liquor. The clean liquor is then run off hot from the top of the tank to feed the steam-boilers, where the larger proportion is evaporated in raising steam, and the remainder drawn off from the boilers into a special evaporating-pan or furnace, where any solid material still remaining is burned down to ash, yielding on further treatment a small proportion of potash.

It is not the province of this paper to follow the various products recovered in the process, and their ultimate uses and effects in the industrial arts; but these are not without interest. The pitch oil is extensively used for lighting in factories and large areas by the medium of "Lucigen," "Wells," and other lamps and torches, and for enriching poor coal gas. It is also employed as fuel in steam-boilers and furnaces. The pitch is utilized in many ways. In a thoroughly equipped colliery, the coals are washed and screened to various sizes, till the ultimate dust is carried off in the washing as mud, which is subsequently dried, steamed, and mixed with a portion of the pitch, and moulded by machines into briquettes. The pitch is also used in all the appliances of asphalte for paving, and for roofing and felting. The commercial sulphate of ammonia, besides its numerous chemical applications, is now extensively used as a manure, and holds a first place as a fertilizing agent. When added to the soil, it readily imparts to it the nitrogen necessary for absorption and assimilation by the roots of plants. It is most widely used in the production of beetroot, and as a top and second dressing on grass lands, and generally for the stimulation of all forms of plant life.

It has been said that the world owes much to the man who can make two blades of grass grow where but one grew before; and though hard things have been said about the desolating of the "coal and iron seeker" in the havoc which he has wrought on the earth's surface, still we have seen how even he has done something to bring back a smile to that fair face of Nature which he has done so much to scar and defile. He may have done all this for selfish ends, as something to compensate him for the low price of pig-iron. But he has paid a debt to Nature in practising economy instead of waste of her forces, and fulfilled a duty to society which might be imitated by other coal users on land and sea; for he has taken full use of his coal gases, and his chimneys are now restricted to their primary use—that of creating a draught, and not for creating an intolerable nuisance.

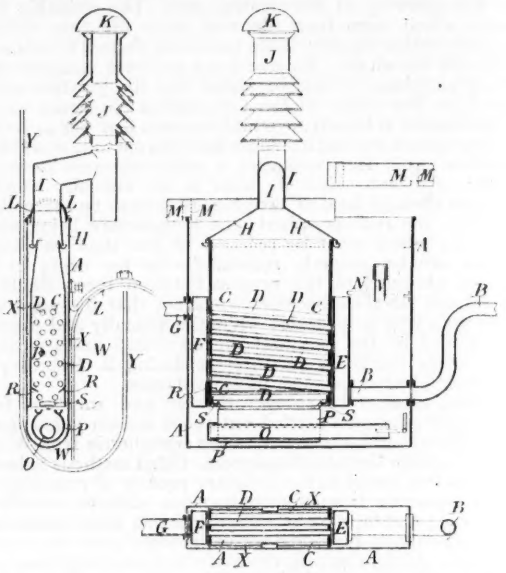
Incandescent Gas Lighting.—The Crays District Council, in their annual report, allude favourably to the trials of incandescent gas lighting in several parts of their district. As, according to the statement of the Manager and Secretary of the Crays Gas Company (Mr. W. B. Mimmack), which appeared in the "JOURNAL" on the 21st of January last, the Company did not feel justified in extending the system beyond the three-cluster lamp they had fitted up at one spot, the Council's allusions are doubtless to the lights introduced by private individuals. The Southend Town Council, rejecting the advice of their Surveyor, which is against the general adoption of incandescent gas lighting, have asked the Gas Company to submit terms for lighting the public streets by this system.

The Registration of Water-Meters.—Complaints are frequently made as to the erratic registration of water-meters; and with some reason if all that is stated by the complainants is true. Messrs. W. A. & A. C. Churchman, of Ipswich, are consumers of water by meter; and they have supplied to a local paper the monthly registrations since June last, as an example of what a "perfected" water-meter can do. For the very wide divergencies shown by the figures below, Messrs. Churchman cannot account. They assert that all their pipes and fittings are in good order, and have been in this condition during the period mentioned, and that no appreciable leakage is therefore possible; also that their business consumption is practically unaffected by seasons, and should be regular and consistent month by month. The dates of the monthly readings and the registrations were—1895: June 4, 12,930 gallons; June 27, 10,300 gallons; July 30, 18,860 gallons; August 28, 30,900 gallons; September 24, 15,580 gallons; October 25, 71,160 gallons; November 26, 75,470 gallons; December 19, 56,030 gallons. 1896: January 23, 45,870 gallons; February 25, 17,620 gallons; March 19, 9720 gallons.

REGISTER OF PATENTS.

Preventing the Freezing of Water in Gasholder Cups and Tanks.—Tritton, C. H., of Peckham. No. 8080; April 23, 1895.

Heretofore, the patentee remarks, various attempts have been made to prevent the water freezing in the cups of gasholders or other exposed positions, by immersing water-heating apparatus therein; but owing to considerable quantities of water of condensation forming internally in such apparatus, and there being no means of draining it off, it has extinguished the gas-flame or other heating medium, and rendered the plant unworkable after a short time.



The illustration shows a transverse vertical section of the apparatus in position in the cup of a holder; a longitudinal vertical section of it apart from the cup; and a horizontal view.

The apparatus consists of an outer wall or case A of any suitable shape (oblong in the engravings) having a boiler or water-heater arranged in it, consisting of two shells, between which is a water space; an inlet B for the water being provided at one end near the bottom. A vertical shaft or passage C is thus formed right through from bottom to top of the heater; and a series of pipes D (advantageously round tubes, arranged on a slope) pass from the water-space E at one end, across this shaft C into the water-space F at the other end—means being provided, if desired, to prevent the flow of water round the casing from one end to the other (such as arranging a division down each side between the inner shell and the outer casing A; or the water chambers E and F may each be a separate compartment, connected only to one another by the tubes D), so that the water passing through the apparatus will all have to travel through these horizontal tubes D, or equivalents therefor. For instance, instead of tubes as shown, vertically arranged hollow plates (not shown) may be arranged in the shaft C, through which hollow the water circulates, and the heat passes up on both sides of the plates.

A water outlet G or outlets (towards the top of the heating apparatus and at the opposite end to the inlet) is provided; both the inlet B and outlet G respectively being below the surface of the water in which the apparatus is immersed or partially immersed. The sides and ends of the outer wall or casing are carried to a sufficient height above the water in which the apparatus is immersed, to prevent any water passing into it over the top of the casing; and the top of the outer case is covered in, so that air can gain access to the burner, with a removable cover in two parts, such as L.

Within the outer wall A, and over the shaft C from the water-heater, is arranged a top or cover H (sloping from the middle towards each side), the lowermost edge of it being above the water-level, so that any water collecting on it can drain through holes formed in the side wall above the water-level. On this cover is mounted a chimney or outlet I provided with a cowl, or down-draught preventer, or air-extractor J. And an outer casing K may be mounted around the top part of the shaft or cowl, to assist the extraction or passage of air or products of combustion round the edges of the hood.

Air to support combustion passes into the apparatus, through double metal gauze N or baffle plates or other means of checking the in rush of air. A large tube (not shown) or a semi-circular cover L may be used, horizontally mounted just across the top of the outer case, the inlet of each end of this cover L being provided with sheets M of gauze perforated zinc; and thence communication is free from this passage to the burner or to the interior of the main chamber, and thence through the double gauze N to the burner. V is a sight-hole through which the burner can be seen.

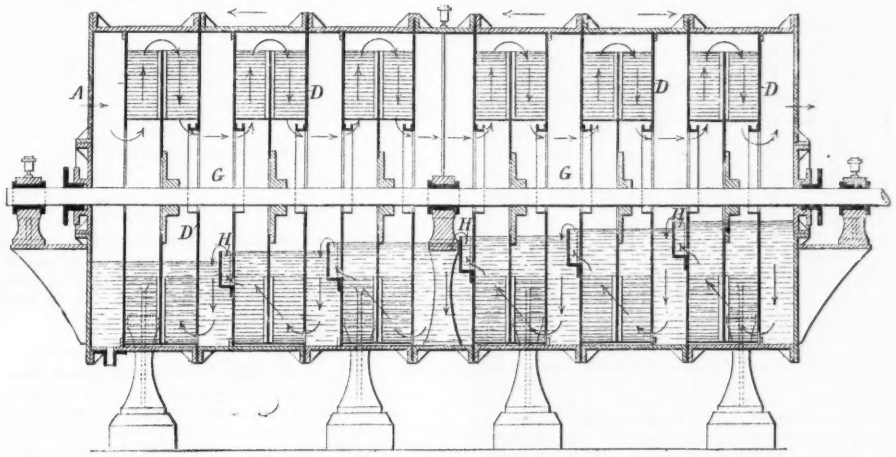
For use on gasholders a bunsen burner O advantageously extends the whole length of the water-heater; and around or along the part of the burner which lies beneath the vertical shaft or central passage C through the water-heater, there is a large slotted tube or enclosing device P (of copper), a longitudinal slot or opening being provided in the top, through which the products of combustion pass up into the vertical shaft C. This evaporating device—which may be smooth or corrugated or ribbed—is so arranged with reference to the shaft that the water of condensation formed on the inside walls of the shaft drops off the bottom edge, and also from the tubes D on to the evaporating device P; or a lip R (or a gutter may extend along each such bottom edge, with spouts or openings at intervals therein) may be arranged to guide

the water of condensation on to it. Being intensely hot at this point, it will convert the condensation into steam, which will pass away with the products of combustion up through the central air-shaft and chimney I J.

S is a collecting gutter across each end of the shaft C, to guide any condensation coming down it into channels of the evaporating device P through short connections. W is the cup formed by the part Y of the holder, into which fits the lip or turned-over part Z; the apparatus being mounted in the cup by brackets bolted thereto and to the holder itself.

Washing Gas.—Holmes, P. F., of Huddersfield. No. 5113; March 11, 1895.

This invention relates to washing apparatus in which "discs, perforated or undulated, or armed with brushes, arranged on a horizontal shaft, revolve partly immersed in compartments of a vessel charged with water or other washing liquid." The object aimed at is so to construct and arrange the compartments and their communications, that "the washing liquid which becomes more and more impure towards the end of the vessel where the gas enters shall not flow back so as to vitiate the more pure portions of the liquid towards the end where the washed gas issues."



Within a cylindrical casing is mounted a horizontal shaft, which passes through stuffing-boxes at the ends of the casing. The casing is divided by a number of partitions, between each pair of which there is a revolving brush. The partitions have openings, by which gas admitted at one end of the vessel at A can pass outwards through one side of the brush, inwards through the other side, and out through D, and so on successively through all the compartments of the vessel, of which there may be any desired number. The lower parts of the compartments between each pair of the partitions, and also the intermediate compartments G, are occupied by the washing liquid supplied at the end whence the gas issues, and discharged at the end where the gas enters—flowing from compartment to compartment; the level at the entering end being lowered by steps to that at the issuing end. But each compartment in which the brushes revolve, and in which the liquid is more or less agitated, communicates with the compartment G, not directly but through a weir H, so that the compartment from which the next compartment in order is supplied at the bottom, remains comparatively still, and operates as a liquid seal to prevent the more impure liquid on the left from going back to mingle with the less impure on the right. The edges of the holes through the partitions are also armed with shields to catch any spray formed, and direct it downwards.

Gas-Motors.—Donaldson, W., of Parliament Street, S.W. No. 6972; April 4, 1895.

This invention, relating to the construction of gas-engines, has for its object (1) to provide means in engines working with the "Otto cycle" to vary the volume of gases produced by explosion, left in the cylinder after the termination of the exhaust stroke, from a minimum represented by the volume of short port-hole passages, to any desired amount; (2) to ensure in the case of a single-cylinder engine that the ratio of expansion after explosion shall, if desired, exceed the ratio of compression before ignition; (3) to allow of the regulation of work done in any of the cylinders of a compounded engine, so that the work in any cylinder may be practically the same or otherwise, as desired; (4) to insure the thorough mixing of the gas and air before entering the cylinder; and (5) to insure the non-occurrence of premature ignition and the certainty of ignition.

The means employed to effect this purpose are as follows: To the back of the ordinary operative cylinder provided with the usual piston, connecting-rod, crank, and flywheel shaft, a regulating auxiliary piston is applied, which enters through the rear of the operative cylinder, and receives reciprocating motion from a crank, eccentric, or equivalent device, fitted to a transverse counter-shaft at the rear of the engine. This counter-shaft is so connected with the main crank-shaft by cog wheels (or some suitable form of gearing), that the counter-shaft revolves at half the speed of the main crank-shaft. The rotation of this counter-shaft at half speed as compared with the main crank-shaft is utilized to operate admission and exhaust valves to or from the operative cylinder—driving the valves by eccentric tumblers on the counter-shaft and connecting-rods, in the usual manner. In consequence of the operation of the regulating auxiliary piston from an eccentric or other equivalent device, capable of adjustment upon the counter-shaft, either as to the throw or stroke of the auxiliary piston (in which case the connecting-rod to the piston is also capable of adjustment as to length), or as to the angular lead or position of the eccentric or other device on the counter-shaft, relatively to the angular position of the main crank upon the crank-shaft, it is possible at any time to regulate the movement of the auxiliary piston, relatively to the operative piston, so that they meet in actual contact, simultaneously, at the innermost points of their respective strokes during exhaust. This eliminates all exhaust products, except as regards the remaining volume contained in the clearance of short ports through the walls of the cylinder.

Illuminant to be Used in Connection with Gas-Lamps.—Robertson, J. C., of Richmond, and Wallace, J., of Melbourne, Victoria, No. 24,073; Dec. 16, 1895.

In this specification, the patentees say: "We are aware that incandescent gas-mantles, composed of metallic oxides and various costly chemicals, are at present in use by being suspended over the flame of a bunsen burner, where they are heated to incandescence; but we have found that a mantle in the form of a thumb stall of a glove, saturated with a solution of more common and cheaper chemicals, mixed and dried under certain treatment, produces an improved illuminant."

The method of applying the illuminant to knitted mantle frames and wicking, and the quantities (apothecary measurement) of the various chemicals used to "solute" twelve mantle-frames are as follows: The mantle frames or wicks are first thoroughly cleansed in soap and water, and then rinsed in pure water, and afterwards dried. They are then dipped into a solution of ½ oz. Epsom salts or sulphate of barium, diluted with six tablespoonfuls of pure water, and afterwards dried in a warm oven. They are then soaked for two hours in a well-mixed solution of 1½ oz. of fluid carbonate of magnesia (British Pharmacopœia); 1 dram of rock alum (reduced to fine powder); ½ dram of nitrate of cobalt or sulphate of iron; and 1 dram of voglite or xanthite. They are then dried in the oven, as before, and finally dipped into the solution of Epsom salts or sulphate of barium before mentioned, and again dried in the oven. The cotton or silk frame of the mantle is then "burnt out" by holding over an ordinary bunsen flame; leaving a pliable mantle, consisting of the ingredients of the solution.

Prepayment Gas-Meters.—Sutherland, A. G., Stidder, J. G., and Everett, J. F., of Stamford Street, S.E. No. 7533; April 13, 1895.

This invention in "penny-in-the-slot" gas-meters relates more particularly to the mechanism described in patent No. 8981 of 1894, for regulating the amount of gas to be obtained for the coins, and for governing the insertion and retention of the coins.

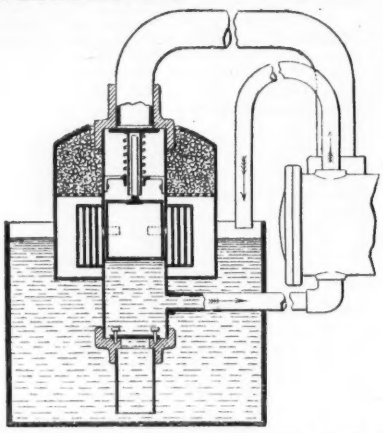
According to the present invention, a revolving drum and ratchet-wheel are fitted to a spindle; the periphery of the drum being divided by scale marks to indicate the quantity of gas to be consumed on prepayment—the drum and ratchet-wheel rotating while gas is being consumed. In connection with the ratchet-wheel, a spring pawl is carried at one end of a free arm, the other end of which is loosely mounted on the spindle; while another arm is pivoted at one end to a moveable and adjustable centre. The radius of the arc through which this arm vibrates is greater than that of the ratchet-wheel attached to the drum. The outer end of the arm is so formed as to throw the pawl out of gear with the ratchet-wheel, by means of the greater arc described by it, assisted by a stud attached to the free arm, and passing through a slot in the arm; the whole being operated upon from the exterior by a lever. The adjustable block, carrying the pivot upon which the long arm works, is a travelling nut, threaded upon a screw-threaded spindle, so that, by turning the spindle, the working radius of the long arm is caused to approach towards or recede from the centre of the spindle; and its distance of travel before disengaging the pawl from the ratchet-wheel is rendered shorter or longer, as required. The screw-threaded spindle is actuated by bevel, worm, or other suitable gear; an opening in the outer case being provided for gaining access thereto, but capable of being secured against interference by the consumer.

Under the slot, is fitted an appliance which receives the coin, and passes it on to the cradle, where it remains until (by the motion of the handle attached to, or connected with, the cover plate) it is caused to move the indicating drum or its equivalent—showing, by the pointer, the amount of gas to be delivered for the coin. The handle may afterwards be moved into position for the insertion of more coins, and recording further increments of gas to the credit of the consumer (limited, however, to one revolution of the indicating drum), by means of a pin or crank attached to the spindle or to the boss of the ratchet-

wheel. This limitation of the number of coins is effected by the combination of the appliance for blocking the slot and a rod or a slot-ended rod working in connection with the pin or crank. This blocking appliance is pivoted horizontally; and it is so mounted that the connecting-rod is capable of moving it across the underside of the slot when the pin or crank has travelled round a complete circle (or nearly so) starting from zero. The lower end of it is formed with a feeler which, on a coin being inserted in the slot, causes the slot to be blocked, and thus prevent any more coins being inserted until the mechanism has been operated upon.

Exhaust Silencer and Circulating Pump for Gas-Engines.—Turner, E., and Harding, G. J., of Altrincham. No. 8197; April 25, 1895.

This invention relates to apparatus whereby the noise produced by the issuing exhaust products of combustion in gas-engines is removed or reduced to a minimum, and at the same time the forces of the issuing gases are utilized to produce a circulation of water between the cylinder jacket and the water-tanks.



The apparatus employed (as shown) consists of a drum, inside which is placed a broad sheet of metal, bent so as to form a spiral coil. Entering at the top and passing down the centre of this is a pipe, which forms a continuation of the exhaust-pipe from the engine cylinder, and which is continued so far downwards that its open end touches the upper side of a reciprocating piston or plunger. When no exhaust is passing, this piston or plunger is held up to (and closes) the open end of the exhaust-pipe; but when the exhaust escapes from the engine cylinder, it has sufficient energy to force the piston downwards. The mouth of the exhaust-pipe being thus opened, the products of combustion escape into the interior of the spiral coil, whence they pass off into the atmosphere, or into a pipe, preferably through layers of coke or some similar substance.

The piston works in a cylinder, which is in general disposed inside the drum at its lower end; and it is connected with the water-supply tank by a pipe which has a valve so arranged that no water can return from the cylinder to it when the piston descends. At a higher level than the supply-pipe, is placed the mouth of a delivery-pipe, which opens into the cylinder (with or without a valve), and the other end of which pipe is carried to any chosen part of the cylinder water jacket. The return pipe from the cylinder jacket passes to the water-supply tank; and by maintaining the surface of the water in this tank at a higher level than the piston or plunger, the latter is (except when forced down by the exhaust pressure) pressed upwards against the open end of the exhaust-pipe.

APPLICATIONS FOR LETTERS PATENT.

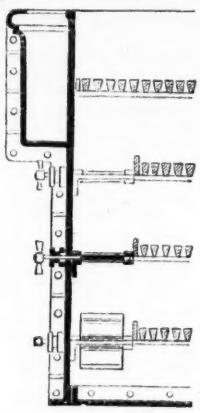
6349.—Hart, H., "Illuminating apparatus." March 23.
6378.—Adorjan, D., "Valve motion and engine for highly overheated steam or gas." March 23.
6408.—Sweetser, A., "Manufacture of oxygen gas." March 23.
6411.—Savor, E., "Regulating the air-feed in bunsen burners for incandescent gas lighting." March 23.
6452.—Gee, H., "Water motors." March 24.
6454.—Clare, A., Neil, A., and Fletcher, Russell, and Co., Limited, "Atmospheric gas-burners." March 24.
6494.—Thompson, W. P., "Burners for incandescent light." A communication from the Continental Gas-Glühlicht-Actien-Gesellschaft "Meteor," vormals Kroll, Berger, and Co. March 24.
6541.—Lea, J. P., "Gas and oil engines." March 25.
6573.—Dowsing, H. J., and Keating, H. S., "Engines worked by gas or combustible vapour." March 25.
6581.—Malberg, J. B. P. W. de, "Incandescent gas-burners." March 25.
6585.—Duke, J. F., "Igniting incandescent gas-lamps." March 25.
6642.—Hunt, J., "Chandeliers, brackets, and such like light holders." March 26.
6665.—Crastin, C., "Device for use with incandescent and other gas-burners." March 26.
6668.—Milsted, W. N., "Prepayment gas-meters." March 26.
6719.—Reitmeyer, R., "Lighting and heating by means of acetylene." A communication from Albert Cerckel. March 27.
6739.—Bayley, J. C., "Generating and storing acetylene gas." March 27.
6740.—Ibbett, J., "Gas, oil, or hydrocarbon vapour engines." March 27.
6794.—Anderson, J., "Prepayment gas-meters." March 28.
6802.—Pease, E. L., and Ashmore, Benson, Pease, and Co., Limited, "Guiding gasholders." March 28.
6847.—Katofius, W., "Gas-lamps." March 28.
6854.—Walker, C. C., "Gasholders." March 28.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Cripps's Patent Purifier Valve.

Sir,—From the description of Mr. Cripps's valve in No. 1715 of the "Journal," one would naturally come to the conclusion that the idea is original, and can be patented. The writer is under the impression that this is not the case, as a similar valve has been in use for many years elsewhere; and for years it has figured in the catalogue of an eminent firm of gas apparatus manufacturers.



The valve in question was a butterfly one, occupying one corner of the tiers, and was actuated from the outside, exactly as Mr. Cripps's is. The only difference I can see is that Mr. Cripps's valve is enclosed in a box. It is difficult, however, to see where either the originality or the patent comes in.

March 31, 1896. Traveller.

Charging for Unregistered Gas.

Sir,—With regard to the question raised by Mr. Lewis (*ante*, p. 693) as to recovering an estimated amount for gas, does not section 20 of the Gas-Works Clauses Act, 1871, meet such a case? The following is the text of the section: "The register of the meter shall be *primâ facie* evidence of the quantity of gas consumed, and in respect of which any rent is charged and sought to be recovered by the undertakers: Provided always, that if the undertakers and the consumer differ as to the quantity consumed, such difference may be determined, upon the application of either party, by two Justices, who may also order by which of the parties the costs of the proceedings before them shall be paid; and the decision of the Justices shall be final and binding on all parties."

Scarborough, April 2, 1896. A. C. Williams.

Increased Coal-Storage for the Leeds Gas-Works.—The Leeds City Council last Wednesday authorized the Gas Committee to erect a coal-store at the Meadow Lane works at an estimated cost of £4000, and one at the New Wortley station at a cost of £3000.

Clevedon Gas Company.—In the report submitted at the annual meeting of this Company, the shareholders were informed that the balance available for dividend was £1447. During the year, 24,949,800 cubic feet of gas were made, of which 18,845,000 feet were sold for private purposes, and 3,352,000 feet for public lighting. Dividends of 6 per cent. on the "A" and "B" shares and 5 per cent. on the "C" shares were declared.

The Mourne Scheme of the Belfast Water Commissioners.—It is announced that No. 6 contract of the Mourne water scheme of the Belfast Water Commissioners has been entrusted to a local firm of engineering contractors (Messrs. H. & J. Martin, Limited). This section is one of considerable magnitude; and it is expected that the time the work will be in hand will be fully three years. The site of operations is in the neighbourhood of Newcastle, Co. Down; and the extent of the conduit works will reach fully 11¼ miles, 2¼ miles of which will consist in the cutting of a tunnel through solid granite rock. The amount of the contract is a little under £100,000.

Sales of Shares.—Last Tuesday, Mr. W. Hammond Riddett, of Messrs. Wallis, Riddett, and Co., submitted to public competition, at their rooms at Ryde, 49 original and ordinary £12 10s. shares in the Ryde Gas Company, upon which maximum dividends of 9 and 7 per cent. are paid. The auctioneer pointed out that shares in the Company are seldom offered for sale, except, as in the present case, through death. There was a large attendance of buyers; and competition was very keen. Of the original shares, 19 were sold for £27 10s. each; 8, for £27 5s. each; and 12, for £27 each. Eight of the ordinary shares were purchased for £21 10s. each; the remaining two fetching £22 10s. apiece. At the last sale by auction of similar shares, the prices realized were £25 5s. and £20 5s. per share respectively. Mr. Riddett has, we learn, recently become a Director of the Company; and therefore he was able to speak with great confidence in submitting the shares to those present.——At the Mart, Tokenhouse Yard, E.C., last Wednesday, Messrs. Fox and Bousfield sold some Horley District Gas Company's £5 shares at £4 7s. 6d. each.——On the same day, 51 fully-paid £5 shares in the Chatham, &c., Water Company were sold in the town for £15 6s. each.——A parcel of 225 original shares of £1 each in the Falmouth Gas Company was offered for sale by auction on the 28th ult. The shares were sold in lots of 25 and 50, and realized £2 5s. 6d. and £2 5s. 9d. per share. The last dividend, declared in September, 1895, was 11 per cent.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

The House rose for the Easter holidays last Tuesday, by which day the following further progress had been made with Bills:—

Bills read a second time and committed: Bexhill Water and Gas Bill, Eastbourne Water Bill.

Bill read the third time and passed: Brighton Corporation Water Bill.

HOUSE OF LORDS COMMITTEE.

Monday, March 16.

(*Before the Earl of* CAMPERDOWN, *Chairman; the Earl of* DARTMOUTH, *the Earl of* BUCKINGHAMSHIRE, *Lord* MENDIP, *and Lord* WIMBORNE.)

COWES GAS BILL.

The Bill promoted by the Cowes Gas Company for authority to dissolve and reincorporate, with further capital and other powers, came before the above-named Select Committee to-day.

Mr. LITTLER, Q.C., C.B., and Mr. C. BAGGALLAY appeared for the promoters; Mr. G. FITZGERALD, Q.C., Mr. J. D. FITZGERALD, and the Hon. G. C. COLVILLE represented the Cowes District Council, who opposed the Bill, a petition against which had also been lodged by Mr. J. DAY, who attended in person to support it.

Mr. LITTLER, in opening the case, explained that the Company were originally formed under a deed of settlement; and they now came to Parliament for statutory powers. It was proposed to make the capital £33,430; £13,430 being the original, and £20,000 additional capital. The former was to be divided into 1343 shares of £10 each, and be vested in the old shareholders. In 1845, the capital was £3000; £2500 of it being paid up. From 1845 to 1864, large sums were laid out on capital account out of revenue—no dividend being paid for five years. For six years, 5 per cent. was paid; and for three years, 7½ per cent. Having ascertained what capital had been expended, new share capital to the extent of another £2500 was divided among the shareholders (this was in place of receiving 10 per cent. dividend); and the rest was put to capital. In 1868, £2000 of additional capital was paid up in hard cash. From 1860 to 1870, the sum of £1630 was spent out of revenue; this being capitalized, and shares to the amount issued—making the total capital £8630. In 1872, more money was required; and £1000 was paid up on shares. In 1873, 200 £10 shares were issued, £3 per share being paid up; and in 1877 these were transformed into 60 fully-paid shares. In 1872, 200 new shares (£2000) were issued; £1400 only being called up, and £600 being paid out of revenue. In 1878, new purifiers were put in, and 120 shares created—£7 per share being paid. In 1880, the other £3 per share was called up. The total capital was thus made up to £13,430, on which the promoters thought they were entitled to 10 per cent. dividend, above which they had never paid. In 1890, it was reduced to 9 per cent.; in 1891, to 8 per cent.; and this had been continued up to the present time. On the new shares, it was proposed to pay 7 per cent. An auction clause had been put into the Bill; therefore if £100 nominal capital fetched £150, the dividend would only be equal to 4⅔ per cent.; besides which it would be to the interest of the Company to keep the capital where it was. It was proposed that the standard price should be 4s. 2d. per 1000 cubic feet, with a sliding-scale under which the dividend would be reduced or increased with every rise or fall in the price. Every penny increase would lower the standard rate of dividend by 5s. on every £100 of 10 per cent. capital, and by 3s. 6d. on every £100 of 7 per cent. capital; and so on in proportion for any fraction of £100. Every penny reduction would have the reverse effect. The quality of gas to be supplied was fixed at 15 candles. The price at present charged was 4s. 4d. per 1000 cubic feet; and he did not suppose it would be increased. When the Company last paid 10 per cent. they were charging 4s. 4d. At Ventnor, the charge was 4s. 6d.; at Newport, 3s. 9d.; at Ryde, 3s. 6d.; at Sandown, 4s. 7d.; at Shanklin, 4s. 4d.; and at East Cowes, 5s. The learned Counsel went on to argue that the Cowes Local Board would have no power to establish gas-works or acquire those of the Company without an agreement with the latter. As to breaking up the streets in the Cowes season, he asserted that the Company abstained as much as possible from doing anything during the months of July, August, and September; and there had never been any friction in this respect. As to the demand that the standard price be fixed at 3s. 9d., he would be much interested if any engineer quoted an instance where such a reduction had been made when the capital had been reasonably expended. He invited his friends on the other side to show any precedent for the compulsory purchase of an undertaking in a company's own Bill; and he concluded by contending that the Local Authority must obtain a Provisional Order authorizing them to raise necessary money.

Evidence was then given in support of the Bill.

Mr. *J. H. Athey*, examined by Mr. BAGGALLAY, said he had been a Director of the Company since 1867, and Chairman since 1886; and he could corroborate the statements in the opening address. He said the Local Authority had never refused permission to open the streets. The town had been rapidly increasing of late years; and the Company had repeatedly extended their works and renewed their mains to meet the growth of consumption—the mains in the High Street having been relaid no less than three times. A sum of money had been devoted to this purpose, accumulated out of income, amounting to £800. The Company had recently been successful in the supply of automatic prepayment meters, giving the consumers 17 cubic feet of gas for 1d. Cooking-stoves and gas-engines were being more freely used. The price of gas in 1864 was 12s. 6d. per 1000 cubic feet; but by 1890 it had been brought down to 5s. In 1881, the price was reduced to 4s. 7d.; and in 1887, to 4s. 4d., down to which time a dividend of 10 per cent. had been paid. When the price was reduced to 4s. 4d., the consumption increased only slightly; but it was now rapidly rising, principally since the reduction to 4s. At Cowes, the make of gas was 17 million cubic feet; at Ventnor, 26 millions; at Newport, 36 millions; at Ryde, 67 millions; at Sandown, 14 millions; and at Shanklin, 5 millions. The expenditure on capital account since 1880 had really all come out of revenue. Portions of the Company's land were freehold, conveyed by the Crown; and partly leasehold from the Ward Estate.

Tuesday, March 17.

On the resumption of the proceedings this morning,

Mr. *Athey* was cross-examined by Mr. J. D. FITZGERALD. He said that £8700 of the capital was actually paid in cash, and £4730 represented the shares distributed without payment before 1880. But this did not mean a 15 per cent. dividend, as for many years they received nothing. He could not say how much money had been expended on capital account, as at that time the accounts were not kept separate. The balance-sheet had been prepared in the same form for fifty years; and it was simply a cash account. The Company had a depreciation fund, which at the present time was *nil*. The £800 worth of pipes had been delivered and partly paid for. Some of the £800 was in the bank and some in Consols. Cowes was not the best situated town in the Isle of Wight for getting a supply of raw material. The coal for Newport was brought in larger vessels at less freightage, taken by rail, and shot right into the store at the works, which saved 1s. per ton over Cowes. The coal for Ryde was landed either at Cowes or at Brading; and for Ventnor, at the latter place. The Company were asking power to borrow in all £8357—making £28,357 of additional capital; but it would not all be called up at once. The largest make of gas in 24 hours was in December, 1895—103,000 cubic feet; and the maximum delivering power was 69,450 cubic feet. It was proposed to take as the limit of supply the whole parish of Northwood, including Gurnard. There was a great deal of building land on the outskirts of Cowes which was being rapidly opened out. Under the Gas-Works Clauses Act, persons could demand a supply on guaranteeing 10 per cent. for three years on the cost of the main. The Company had laid mains, at the request of the Local Authority, in streets where there was no consumption. If the Bill passed, the Company would have power to supply gas, and the District Council electricity. The Company had declined to insert a clause giving the Council power to purchase, as they preferred to keep their property. They had never been asked to sell.

Mr. FITZGERALD read a copy of a letter to the Company, dated Jan. 8, 1896, asking if they were prepared to sell, and on what terms; and a reply dated Jan. 14, declining to entertain the question.

Mr. DAY, the other petitioner against the Bill, was cross-examining the witness when

The CHAIRMAN interposed, and remarked that as his petition had reference to land, it was a question of clauses.

Mr. DAY argued that the Bill was intended to consecrate, so to speak, some transactions which occurred many years ago.

The CHAIRMAN said the Bill could not establish or defeat any rights Mr. Day might have. If he claimed land at that moment wrongfully held, that was a matter for a Court of Law, and had no reference to the proprosal to purchase the land.

Mr. DAY replied that this was not a proposal to purchase. The land was taken possession of many years ago wrongfully. If the Bill passed, all remedy would be defeated.

The CHAIRMAN said if the Company had done wrong, passing the Bill would not make it right. This was so obvious, that he could say nothing more about it.

In re-examination by Mr. BAGGALLAY, witness said that during the fifty years of the Company's existence, there had been no complaints as to the conduct of the gas-works, the quality or quantity of the supply, or anything else. He could not say that harmony existed with the Local Authority, as they had done all they could during the past five years to oppose the Company by putting up oil-lamps.

Mr. *W. Halliday*, the Secretary of the Company, said that in 1882, when they were lighting the public lamps, the sale of gas was 15 million cubic feet; and last year it was about 16½ millions for private consumers only. It took about 1¾ millions to supply the public lamps. In 1895, the Company had 552 customers—an increase of 20 per cent. on the year 1893. About 50 automatic prepayment meters had been put in, and there were some 20 other applications. After giving evidence with regard to the accounts, witness went on to say that the Company had repeatedly tried to arrange with the Local Authority for the public lighting. When the price was 4s. 4d., they offered to supply the public lamps at 3s. 9d.; and when it was 4s., at 3s. 6d.

Mr. J. D. FITZGERALD cross-examined witness with the object of showing that only a comparatively small sum had been taken out of revenue for capital purposes.

Mr. *Corbet Woodall*, M.Inst.C.E., said he had inspected the Company's works and the area of supply; and he was of opinion that the £13,430 of capital had been put into the undertaking. The quantity of gas sold was roughly 16½ million cubic feet. Dividing the capital by this figure, it worked out to £820 per million; or by the make, £722. Judging from other companies of the same size, this was a low capital for the business done. There could not have been any extravagant expenditure upon the works; but they were in excellent order. With regard to the mains, there was room for improvement. They were in some cases too small, and it would be advisable to enlarge them; and extensions were required to districts not at present supplied. Capital expenditure would shortly be necessary on these accounts, as well as for meters, stoves, and service-pipes. Automatic prepayment or "slot" meters had been one of the most remarkable developments of modern times; and the only limit to their adoption was apparently the capacity of the manufacturers to produce them. He was sure the demand for them would increase. He thought it was not unreasonable for the Company to ask for an amount of capital which would enable their business to be rather more than doubled; and this would keep them away from Parliament for about fifteen years. He had estimated that the business would be doubled in about eight years; and if it did so, and doubled again in a similar period, they would reach an output of 68 millions in seventeen years. At £500 per million, this would work out to £25,500.

The price proposed was 4s. 2d. per 1000 cubic feet. The Company were now charging 4s.; and this seemed to him to be not more than sufficient to provide them with the dividend they had been paying. They had, up till July last, been charging 4s. 4d.; and he considered that the suggested price—being a little less than that, and rather greater than the present figure—was a fair one. The practice of Parliament had been invariably to allow a slight margin.

In answer to the CHAIRMAN, witness stated that when he said that, in order to make it quite certain that the Company would be able to keep up their late dividends, the Committee ought to allow them a margin on the initial price, and that therefore it was necessary to have 4s. 2d., he had not in his mind the fact that, besides their dividend, they had been putting aside profits which they did not divide.

In cross-examination, witness said he did not think it was the case that when a company came to Parliament to ask for the sliding-scale and a slight margin, the proposal was usually vigorously opposed by the parties on the other side, and that Parliament arbitrated between them. If the standard price in this case were fixed at 4s. 2d., the Company would be able to charge 4s. 10d. without altering their present dividend. Where Parliament was asked to capitalize money spent on capital account out of revenue, the ordinary practice was to allow 5 per cent. interest; but here there was no application to capitalize money spent out of profits since 1880. It was not proposed to ask a penny for the £2400 of expenditure since that year. His figure of £820 per million was not an extravagant one; but he acknowledged that there were places where it was much less. He certainly could not accept £650 as a fair average. He did not remember the introduction of a purchase clause into a Bill against a company's wish, even in the case of a non-statutory undertaking. Being referred to the Accrington case, witness admitted saying that there were numerous instances in which companies before Parliament had been obliged to come to an agreement, and this had been made part of the Bill; but he explained that this was the result of an agreement. He was engaged in the Cockermouth, Falmouth, and Rhyl cases, where the Companies were put under terms of purchase; but in each instance it was by agreement. He based his estimate as to the duplication of the consumption of gas in eight years upon the increase of 15 per cent. last year. From 1894 to 1895 it was 10 per cent.; and with 8¼ per cent. per annum it would double in eight years. Taking an average of four years, it came down considerably. He did not think it extravagant to take a little more than half the increase of last year as a standard.

Mr. *H. E. Jones*, M.Inst.C.E., said he had made a structural valuation of the Company's works; and it amounted to £13,182. But beyond this, they would require some money for floating stocks of coal, book debts, and a banker's balance—in other works, working capital to the extent of £600 or £800. He had taken the land as freehold. The works were at present in very good order; but it would be necessary to increase them shortly. He thought it was requisite that the Company should have power to raise additional capital as proposed by the Bill; and he considered the amount should be £20,000, with borrowing powers. If the Company extended at all, they would require at least £500 per million cubic feet in order to meet the extra sale. He had had great practical experience of the automatic prepayment meters referred to by the preceding witness; and he knew they were in great demand. There were, however, few in use at present at Cowes, and very few gas-stoves; and he thought that when gas was more employed for heating, and a greater number of the coin meters were introduced, there must be a considerably larger demand for gas. He estimated that the increase would be about 10 per cent. for some years to come. With regard to the price, he thought the initial charge should be something above the present. As far as he had looked into the accounts for the past three years, he thought the present price would answer the Company's purpose; and last year even less than that, because there was an abnormal expenditure. But inasmuch as they were buying coal at probably "drought" prices, he thought it would be safer to make some small addition to the figure they now found sufficient, when corrected by that abnormal expenditure. When he said "safer," he meant from the point of view of the shareholders; and under the sliding-scale there was a great temptation to work below it. He regarded the sliding-scale as a valuable thing, both to the shareholders and to the consumers. He knew that since 1880 the Company had expended £2400 out of revenue on capital account. Supposing they had not incurred this expenditure, they might have paid a dividend of a little more than 9 per cent., instead of only 8 per cent., which they had recently declared; and he thought it was reasonable that the initial price should be fixed slightly above the 4s. which came into operation for the first time last year.

In cross-examination by Mr. J. D. FITZGERALD, witness said the works were to some extent too large for present requirements; there being a slight margin in regard to retorts and purifiers, but not in respect of storage capacity. It was cheaper to extend than to initiate works; but £150 per million cubic feet would certainly not be a good margin between the expense of extension and of first establishment. He thought works of the size of those at Cowes might be constructed for about £700 per million cubic feet, and extended for about £500 per million. It was much cheaper to put up gas-works now than it was thirty years ago. He had not been able, from the Company's accounts, to make any calculation as to the cost of making gas.

This closed the case for the promoters, and evidence was called on behalf of the principal petitioners.

Mr. *E. H. Stevenson*, M.Inst.C.E., said he had inspected the Company's works, and found them to be in good order and well kept. When a company came to Parliament to have expenditure out of revenue capitalized, the ordinary rate of interest was 5 per cent., though in many cases the original capital of the Company and that which had been spent out of revenue had been added together (the original bearing 10 per cent., and the additional 5 per cent.), and then upon the whole of it an average of 7 or 8 per cent. allowed. Applying this principle to the Company's existing capital of £13,430, it worked out to rather more than 7 per cent. In the case of old companies such as this, the ordinary amount of capital to reckon, if they were equal to, and no larger than, their requirements, would be about £650 per million, as against the £820 shown. The Company were asking for £20,000 of new capital; and borrowing powers to the extent of about £8000. The Company had increased very slowly during the past twelve or thirteen years; and when more capital was applied for, a period of ten or twelve years was generally taken, to see what the growth has been during that time. In the present case, it had been less than 2 per cent. per annum; and if it continued only at this rate, a very few thousand pounds would suffice to carry the Company on for twelve or fifteen years. They had power to borrow on their old capital £3557; and this would enable them to make their works 50 per cent. larger than they were now, which would take them on certainly for the next fourteen years. But in order to enable them to carry on their works without additional capital, it would be necessary for them to exercise their borrowing powers.

The CHAIRMAN: I gather that you would prefer that the Company should work by raising money by borrowing, rather than by the issue of new capital?

Witness: Certainly they should, if the borrowing powers are properly regulated; but as they are put in the Bill, the Company would raise money on loan at a higher rate than the share capital.

By Mr. J. D. FITZGERALD: At present, if the Company desired to raise money, supposing the Bill passed in its present form, and they chose to borrow it in the cheapest way, they could raise it at (say) 3½ per cent.; but they would not be under any obligation to borrow it at that rate. It was 5 per cent. in the Bill. The result of this was that, unless the auction clauses were applied to the borrowing powers as well as to the capital powers, there is no sufficient security provided for the consumer.

The CHAIRMAN (to witness): The substance of your answer is that you think that power ought to be given to the Company to proceed by borrowing rather than by issuing share capital; but that they ought to proceed by borrowing subject to the auction clauses.

Witness: Yes; if they were able to borrow this £3557, it would be sufficient for them for seven or eight years.

In further examination, witness said he thought about 3s. 9d., or 3s. 10d. at the outside, would be a fair standard price. The accounts for 1895 showed that the Company had expended a large amount out of revenue upon repairs and renewals—in his opinion, 8d. per 1000 cubic feet more than was necessary. This would represent a sum equivalent to a dividend of about 4 per cent. His figure of 3s. 9d. was a reduction of 3d. on the present price. One penny per 1000 cubic feet represented something less than 2 per cent. on the dividend; and the 3d. (or 5d., he might say, because the average for the year was 4s. 2d.) which he suggested was a proper amount to be deducted was 5d. off the proposed standard. Passing the Bill in its present shape would put up the value of the Company's undertaking 25 per cent. at least. The market value of the shares would be raised. A share that was worth £10 before, would become worth £12 10s., and probably more. As a matter of fact, in cases of arbitration, it was taken as an accepted canon that a statutory company was worth a greater number of years' purchase than a non-statutory one; and if the Local Authority were to acquire the Company's undertaking, the present would be the time to do it—now that it was a non-statutory concern, and before any large extra expenditure of capital took place. Assuming that the power of compulsory purchase were put in the Bill, if the concern were bought up as a statutory undertaking, they would receive five or six years' more purchase than if they were acquired as a non-statutory one. New capital could be raised at a lower rate generally by local authorities than by gas companies. In his experience, purchase clauses had been put into gas companies' Bills where non-statutory companies were asking for incorporation. In the Dundalk case, in which he was engaged, that was a non-statutory Company; and a clause was inserted in the Bill giving the Dundalk Commissioners power to acquire the works at any time within seven years of the passing of the Act. And there was a proviso to the effect that, if the Commissioners should within three months of the passing of the Act give notice to the Company of their desire to purchase, the Arbitrators or Umpire, in determining the price, should not have regard to the fact that the Company was incorporated, but should add to the amount of the award the actual cost of obtaining the Act. This was put in for the very fact that otherwise the value of the concern would be increased in arbitration. This clause enabled the Commissioners to buy at once, on the footing of the Company being a non-statutory one; but the purchase did not take place.

In cross-examination, witness thought the fact that the Cowes Company had written up their capital was a "grievance" which justified the application for a purchase clause by the Local Authority.

The CHAIRMAN remarked that the Committee had not heard anything to make them think the capital of £13,430 was unfairly piled up.

Cross-examination continued: Assuming that £13,430 was the original capital allowed, the petitioners merely asked that the dividend should not be 10 per cent. He did not know of any case in which a company had, more than sixteen years before they came to Parliament, issued shares in respect of revenue, as the Cowes Company had done; but he did know of one where a company had borrowed money, as they thought, rightly, and Parliament limited their dividend to 6 per cent. until they had paid it out of otherwise divisible profits. By coming to Parliament for incorporation, the value of a company's undertaking was improved; but the consumers did not get so much advantage as if the local authority had the works. He admitted, however, that they did get certain advantages, in the limitation of profits, the standard price, the auction clauses and the sliding-scale, an audit of accounts, and these made out in proper form. With regard to his suggested initial price of 3s. 9d., he should say that with it the Company would be able to pay 8 per cent. dividend. He had taken the figures for 1895, and he made the cost of gas 2s. 3d. per 1000 cubic feet. The amount required for an 8 per cent. dividend was 1s. 4d.; making 3s. 7d. Therefore 3s. 9d. would be more than sufficient. He thought the initial price should leave only a bare margin above the figure required to produce a particular dividend. Assuming 10 per cent. to be the right dividend, the margin should be 3d. if the management was good; but in the present case he considered it was not good. The salaries and wages were high, and the make of gas per ton was small.

In re-examination, witness said he held to the opinion that 3s. 9d. would be a fair standard price for an 8 per cent. dividend; and, having regard to the amount of capital which had been raised out of revenue, 7½ per cent. would be a proper standard dividend.

Mr. J. D. FITZGERALD then addressed the Committee, urging them to make provision for the purchase of the works by the Local Authority. No harm would, he said, be done to the Company by the insertion of a purchase clause, as they would get what the undertaking was worth, and probably more.

Mr. DAY then repeated the arguments used by him in the earlier part of the proceedings.

The CHAIRMAN replied to them as before; whereupon Mr. Day withdrew his petition.

Wednesday, March 18.

On the resumption of the proceedings this morning,

The CHAIRMAN, addressing Mr. Colville, asked whether, if the Committee inserted a purchase clause, and the Council purchased under it, the rest of the Bill would drop.

Mr. COLVILLE said it would.

Mr. *G. Fellows*, a member of the Cowes District Council, and also of the Lighting Committee in charge of the Bill, having been called, at the request of the Chairman, to give evidence as to the reason for the town ceasing to use gas,

Mr. BAGGALLAY addressed the Committee on behalf of the promoters. He said there were four points to be considered. First there was the question as to what should be the rate of dividend allowed in respect of what was called in the Bill the original capital—whether it should be 10 per cent. over the whole, or 8 per cent. The second point was as to the initial price—whether it should be 3s. 9d. or 4s. 2d. The third point was as to the additional capital. The fourth matter was the purchase question—whether or not the District Council should have the necessary powers conferred upon them. The learned Counsel proceeded with his argument on the first point. In the course of it,

The CHAIRMAN said he would not trouble Counsel to go further, as the Committee were satisfied that the whole of the original capital was entitled to 10 per cent. as a standing dividend.

Mr. BAGGALLAY next passed to the questions of the initial price and the power to purchase. He contended that the correspondence which had taken place between the Council and the Company did not bring the matter to a question of purchase or no purchase, as one generally understood it. He said that if the Council had come to the Company before they issued their parliamentary notices, and expressed a willingness to discuss this matter with the view of arriving at some arrangement, it would have been much to the Company's discredit if they had refused. But the Council waited until the Company had deposited their Bill; and then came and asked them only one question. From the beginning to the end of the Council's petition, there was not one suggestion of grievance; and where a company was doing its work well, purchase powers were refused unless the company were willing to sell. If they were doing their work badly, a local authority could only get powers of purchase by going to Parliament with a Bill of their own. The learned Counsel dealt with various precedents on this point, and concluded by citing the provisions of the Public Health Act in regard to a local authority being precluded from setting up a competing supply of water when there is an authorized company in the district able and willing to furnish it. If this was the case with water, was it not, he said, ten times stronger in the case of gas, particularly when, as in the present case, the authority were themselves applying for electric lighting powers.

Mr. COLVILLE also addressed the Committee, dealing specially with the Dundalk case which had been cited.

The CHAIRMAN (interposing) remarked that in that case the Commissioners promoted a Bill on their own account to deal with the matter; and that, to his mind, constituted a very great difference between it and the present case.

Mr. COLVILLE then proceeded to explain that the District Council had no intimation of the Company's Bill until they saw the parliamentary notices; and they could not then promote a rival Bill, as was done by Dundalk. Their only method of procedure was to ask Parliament to insert a compulsory purchase clause.

The Committee having conferred together,

The CHAIRMAN announced that the Committee had decided that the Bill should proceed; and consequently the rest of the arguments might be upon clauses.

Mr. COLVILLE asked if their Lordships had decided not to insert a clause for compulsory purchase.

The CHAIRMAN: Yes.

Mr. COLVILLE said in that case he was instructed to withdraw, as the Council would not proceed further there.

The Committee then went through the clauses. Those relating to capital were passed; the initial price was fixed at 4s.; and clauses were inserted to prevent breaking up roads during July and August, and making it clear that the Company will not interfere with East Cowes.

Monte Video Water-Works Company, Limited.—At the ordinary general meeting of this Company next Thursday, the Directors will submit the accounts for the past year. They show that the gross revenue amounted to £75,602, being a decrease of £319 as compared with the previous twelve months. The net income was £45,151, as against £46,788 14s. 10d. in 1894. After providing for interest and other charges, and setting aside £1200 as provision for possible loss on outstanding accounts, there remains an available balance of £21,661, out of which an interim dividend of 2½ per cent. was paid on the 1st of November last; and the Directors now recommend a further dividend of 2½ per cent., making 5 per cent. for the year, free of income-tax—carrying forward a balance of £1661. The sale of water has again been seriously affected by the abnormally wet weather which prevailed during the whole of last year; the rainfall amounting to 67 inches, as compared with 44 inches in 1894, and an average of 37 inches over the last ten years. This excessive rainfall, besides affecting the income, has materially increased the expenses, the frequent flooding of the river necessitating additional work on the filters. At the last general meeting, full information was given to the proprietors as to a project brought forward in Monte Video, on behalf of a local private Syndicate, for an additional water supply to the city. The scheme remains in practically the same position as it was a year ago.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, March 30.

(*Before Mr. Justice* WILLS.)

Incandescent Gas-Light Company, Limited, v. Sunlight Incandescent Gas-Lamp Company, Limited, and Others.

On the resumption of the proceedings this morning,

Mr. BOUSFIELD continued his address on behalf of the defendants. He said it was only natural that a patentee or a company which was working a patent, and had made it commercially successful, should have the sympathy and assistance of the Court; but on the other hand, the rights of the public had to be considered.

Justice WILLS remarked that he did not require any warning of this kind.

Mr. BOUSFIELD did not intend his words to be taken in that sense, but only as introductory to the proposition that the public had only the specification to guide them, as to what they could do and what they could not do; and that legitimate and fair competition was not to be interfered with by vague and indefinite claims. It was one of the elementary conditions on which a man obtained a patent, that he should clearly describe and limit the field in which he claimed to have a monopoly. He should have thought it was clear upon the face of it, that one of the essentials of the specification was that there should be a compound of zirconia and lanthana, with or without some other substances or equivalents—the mantle being prepared by a certain process. But it was suggested that, apart from what was definitely stated and claimed, there was something which might be called the pith and marrow of the invention; and that it had to be decided on the question of infringement, whether there had been a taking of that pith and marrow, as shown by extrinsic evidence, outside the terms of the specification. He submitted that the authorities, particularly *Clark v. Adie* and *Nobel v. Anderson*, clearly laid down that the pith and marrow, or substance of the invention, was to be determined by the language of the specification itself, and not by extrinsic evidence. Several passages from these cases were cited; and he submitted that if Welsbach had intended to claim a mantle of zirconia—and it was said here that a zirconia mantle was an infringement—he ought to have said so, and, as was stated in *Clark v. Adie*, have claimed that "subordinate integer" specifically. From the point of view of the public, it was highly important that this strict construction of specifications should be insisted upon, as it always had been in recent times by the House of Lords. Further passages from the evidence were read in illustration of this point. There had been no serious attempt on the part of the plaintiffs to say what were the limits within which the public might not work, but outside of which they were free to experiment and make further progress. If anything which his friend called a "Welsbach skeleton" was included, then he submitted that the specification was bad—first, for insufficiency, and secondly, because a great many things would be included which were useless. Mr. Ballantyne's evidence showed this clearly. He also contended that, if a Welsbach skeleton were within the specification, it was anticipated by Stokes-Williams. Mr. Dugald Clark's evidence made it quite clear that in 1885 zirconia was well known as an incandescent material, but that a compound or blend was required to make a commercially successful light. All this supported the view that the patentee only intended to claim the particular combinations which he had found to be successful. He then went on to argue that, according to the plaintiffs' contention, the words "treated as set forth" were mere surplusage, and might be struck out. There was nothing whatever in the specification referring to the decomposition of the salts by the flame, and the formation of a coherent film of oxides by that means. "Treated as set forth," must apply to the treatment with ammonia, which effected the reduction to oxides; and the omission of the ammonia made it an entirely different process. He then cited a passage from the case of *Wood v. Zimmer*, to show that a patentee was bound to give the public in his specification the best information in his possession, so that on the expiration of the patent they might be in as good a position as himself to practise the invention. If the specification were read in the limited sense he contended for, it was good; but if the wider range suggested were to prevail, it was bad on the ground stated, because there was no reference to thorium, the importance of which was known to the patentee at the date of the complete specification. The learned Counsel then passed on to a few remarks on the question of the ammonia treatment. He said the question of making or not making mantles had been carried a little further; and evidence would be given showing the results. Another sample of Mirck's zirconia had been obtained, which would not make successful mantles. His Lordship would see, on looking at the specimen, that among the scales there were little white grains intermixed, which were at first thought to be an impurity; but on analysis, they were found to be the same substance. This specimen, on analysis, was found to contain 1·4 per cent. of impurities, consisting of magnesia, soda, and potash. It was therefore practically pure; but when the mantles were ammoniated, they fell to pieces. Dr. Hehner had further purified it, until it had only 0·4 per cent. of impurity; but still it was unsuccessful, although by purifying it in a certain way it would make an exceedingly fragile and friable mantle.

Dr. *Hehner*, was then called, and narrated his experiments with the last-named specimen of Mirck's nitrate of zirconia. He first tried to make a mantle with it alone; and on treatment with ammonia, it fell to dust. He then analyzed the zirconia; and found the grains and scales practically identical. He could find no traces of other rare earths; and the total impurity was 1·4 per cent. He considered that practically pure. The very purest caustic soda or potash in commerce would not be more than 98 per cent. He, however, further purified the zirconia by means of ammonia, until it only contained only 0·4 per cent. impurity. He could not make a coherent mantle with the solution. On mixing it with lanthana, and making mantles, they would not hold together sufficiently to put them on a burner, except in one case, and that was very imperfect. Coming to the Sunlight mantles,

he did not consider a zirconia mantle alone would be a commercial success. The addition of chromium to zirconia improved it slightly; but when added to an alumina mantle, a very good result was obtained. This was quite unknown at the date of Dellwik's patent. [Two mantles were then lighted, made of pure alumina; and they gave very little light. Witness stated that the illuminating power was 1 candle per 3 cubic feet per hour. The gas was then turned off, and 1 per cent. of chromic acid in water was sprayed upon the lower portion of it, and in a few minutes a strong yellowish light was developed. Witness, however, stated that he had hardly put sufficient chromium upon it.] Continuing his evidence, witness said he considered Stokes-Williams plainly contemplated what had been called a "Welsbach skeleton." He had tried an alumina mantle dipped in a solution of an iridium salt, which on burning gave a deposit of the metal in a finely divided condition. When the amount present was small, a considerable addition to the light was produced. He agreed generally with Mr. Clark that Welsbach probably used lanthanum for the purpose of light, and zirconia to give strength. A proper blend was absolutely essential to success. He believed the patentee used the ammonia because he had an acid solution, which would have rotted the mantles, and which he wished to neutralize. When the ammonia was omitted, the same result was obtained ultimately, but by a different process; and the omission of the ammonia added greatly to the strength of the resulting mantle. Without the ammonia, the salts became fused, and gave a coherent oxide; but this fusion was not possible after treatment with ammonia, except to a very limited extent in the case of lanthana. There was nothing in the specification to suggest this.

Cross-examined by Mr. MOULTON: He had the specimen of Mirck's zirconia last referred to on Thursday evening. He was called in to advise the defendants about six months ago. He was not then aware what they were making their mantles of, and did not know now. He read in Mr. Crookes's evidence that a rare earth was used which was not named. Alumina and zirconia would make a coherent mantle, which would give out very little light. Zirconia was more brilliant than alumina. He believed the best way of adding the chrome was to spray it on; but no doubt the materials might be all mixed together and the mantles dipped in the solution, or they might be dipped twice.

Re-examined: The sample of Mirck's zirconia was analyzed on Saturday and yesterday. When the matter was mentioned on Friday, he knew that it would not make mantles; but was not acquainted with its composition.

Mr. *C. B. Freeman*, a clerk in the office of Messrs. Maddisons, defendants' solicitors, was next called to prove the appointment of three gentlemen (Messrs. Duncan, Morris, and Wethered) as Directors by the subscribers to the Memorandum of Association.

Cross-examined: He did not know when Mr. Sugg was first connected with the Company. The Directors were appointed immediately after the registration of the Company. The subscribers to the Memorandum were Directors, according to Table A, for a few hours, until the Directors were appointed. He got the signature of each subscriber to the appointment.

Mr. *A. M. Cheyne* was the next witness. He said he was a qualified chemist in the employ of Messrs. Burgoyne, Burbidges, and Co. Zirconia was listed and offered for sale before 1885; and was dealt with in small quantities—principally the metal, the chloride, and the oxides. In 1881, he had seen the salts and oxides in the catalogue. The chloride was quoted in the 1881 catalogue at about £3 an ounce. Several wholesale houses supplied it.

The evidence of Mr. Crookes, taken on commission before he left for South Africa, was then read by Mr. EMERY. He narrated therein some of his experiments on incandescent bodies. He stated the chemical reactions which take place in the manufacture of Welsbach mantles; and gave his opinion that the treatment with ammonia was detrimental, and made the mantles practically useless. His evidence also went to Frankenstein's solar and lunar light, Clamond's patent, and Stokes-Williams's specification. He stated his opinion that the latter anticipated Welsbach, if the broad interpretation sought to be put upon it by the plaintiffs were adopted. Welsbach said nothing about the strength of the solution to be used; and experiment would be required to find out what were the proper strengths.

Mr. MOULTON then read the cross-examination. In it, he admitted that portions of Stokes-Williams's specification were unintelligible and obscure; but he would not say, though repeatedly pressed, that it was a "farrago of nonsense." At the date of the 1885 patent, it was not known that a skeleton could be formed of the rare earths by impregnating an organic fabric and then burning it. He had never made the burner described by Frankenstein. The ordinary bunsen burners in use in chemical laboratories, would not produce a good effect with the Welsbach mantles. The 2½ per cent. of the secret material used by the defendants was a rare earth. A good part of the examination had reference to the Haitinger patent, which, not now being relevant, was not read.

Mr. WALLACE then read the re-examination, which was not long, and raised no new points.

Mr. WALLACE said he now proposed to light one of the defendants' mantles, prepared without the secret substance, which had been found not to be of importance, and was no longer used. If his friend desired, he would hand up the name of the substance to his Lordship; and he might say that it was not one of the rare earths in the sense of which that term had been used.

Mr. *David W. Sugg* was then called, and stated that defendant's mantles were made of alumina and zirconia, and a small percentage in chromium. Ammonia was not used in their manufacture.

Cross-examined: The mantles were chiefly manufactured under his superintendence.

Mr. *J. H. Taylor*, who was called as an expert in microscopical and chemical matters, said he received some solutions and materials from Dr. Hehner. He received two solutions. One, marked "A," he understood was prepared by the defendant Company; and the other, marked "B," was part of a solution handed by the plaintiffs to the defendants in Court. He unravelled some of the fabrics, soaked the fibres in the solutions, and then prepared highly magnified photographs of them, which he produced. Some were treated with ammonia; and others were not. They were then mounted and burned, before being photographed. Witness marked on the backs of the photographs the class of fabric represented—whether ammoniated or burned, or not. He said he found very little variation in the solutions furnished by plaintiffs and defendants when unburned; but after burning, there was a considerable difference. After treatment with ammonia, the fibres were more constricted and less permeable to light; and when burned, this difference was much more marked. He also tried the tensile strength, both longitudinally and crossways; and in each case the ammonia weakened the tensile strength. When not treated with ammonia, the outlines were cleaner and straighter.

Cross-examined: The photographs represented the ultimate fibres of the cotton. The threads were soaked in the solutions suspended over ammonia, then dried, and afterwards dissected into their ultimate fibres. The smoother ones were made with the defendants' solution; and the rougher from that of the plaintiffs. The defendants' were the strongest.

Re-examined: All the specimens were treated exactly alike. He made a large number of tests of tensile strength. Unammoniated, the mean of 51 trials was 3·45 grammes; ammoniated, the mean of 36 trials was 1·85 grammes. These were made from solution "A." The figures from "B" solution were rather less. The general conclusion he drew was that the treatment with ammonia weakened the filaments considerably in each instance, but most of all in the case of the Sunlight solution.

Dr. *Hehner*, recalled, stated that the solution "A" was one made by himself from Mirck's zirconia, with lanthana and yttria, according to Welsbach's specification. Solution "B" was a portion of that handed him by Mr. Swinburne, as representing the plaintiffs' solution.

Mr. WALLACE said the only remaining witness was Sir H. Roscoe, who could not be present until the next morning.

Tuesday, March 31.

When the Court sat this morning,

Sir *Henry Roscoe* was called, and examined first as to the direction in the specification to treat the fabric with ammonia gas. He was shown the photographs produced by Mr. Taylor, and said the difference in the appearance was very marked. The fibres which had been treated with ammonia were rugged, uneven, and evidently much less coherent. He considered the omission of the ammonia made the process a different one. When heat was applied to a fabric soaked in a solution, such as was described in the patent, the nitric acid was driven off, and an anhydrous oxide deposit left. According to the temperature of the flame, and the nature of the oxides produced, would be the degree of fusion—semi-fusion, or complete fusion—which would take place. He considered the question of the blend employed and the proportions most important; a very small quantity of some substances making a great difference in the effect produced. The strength of the solution was also very important. With regard to the alleged infringement, the element which gave the illuminating power was chromium, in a very small quantity. It was not known in 1885 that chrome had this property; he had seen no reference to it in connection with lighting before Dellwik's patent. He considered the sample of Mirck's zirconia which had been found to contain only 1·4 per cent. of impurity might be called a pure article. This would apply to almost any chemical substance with such a high degree of purity. The only exceptions he should make would be bodies which could be readily crystallizable, which might be obtained with almost 100 per cent. of the pure substance. For the purpose of this manufacture, he should call 98·6 per cent. pure. For very delicate operations in chemistry (such as the determination of atomic weights), greater purity was desirable, and might be attained by taking great pains and trouble. Chromium did not belong to the class of rare earths; it was one of what was called the iron group. He had been astonished to find the effect produced by a very slight addition of chrome to an alumina mantle. It made all the difference in the illuminating power, and also in the character of the light, but only after a time. A pink compound was formed; and it was this which gave the peculiar yellowish light, quite distinct from the very white light of alumina.

By Justice WILLS: He did not consider that thorium fell within the ytterite group.

Cross-examined by Mr. TERRELL: Chemists grouped substances according to the properties they possessed. There were certain analogies between chromic oxide and alumina. They were highly refractory, and gave continuous spectra; but this was a property they shared with all solid bodies. They were both difficult of reduction. These properties they had in common with the rare earths, as well as with many other substances. They also emitted light in a bunsen flame; but alumina did so to a very slight extent. He did not agree with Mr. Crookes if he classed alumina and magnesia with the rare earths. He should not class them together, even for the purpose of making incandescent mantles. He could not speak from his own knowledge as to what was known about the incandescent qualities of the rare earths in 1885, or that they would make coherent mantles. He was not aware that a skeleton had been made before 1885 of any of the rare earths, by dipping a fabric in a solution and then burning, with the possible exception of zirconia, which he believed was mentioned by Stokes-Williams. He had no personal knowledge about it, and had only seen Stokes-Williams lately. He did not know that the defendants' method of manufacturing their mantles differed substantially from Welsbach's, except in the fact of using the two solutions separately. All the zirconia salts had a strong tendency to become basic. The term nitrate of zirconia would probably mean normal nitrate, unless something else were said; but normal nitrate was very difficult to prepare. He had made no experiments himself with Mirck's nitrate. In Welsbach's specification, zirconia was a substantial ingredient. Alumina was referred to as a material which might be added at the top of the mantle, for the purpose of strength; it would not make a good mantle in itself. He could not say whether, if added to a zirconia mantle, it would injure the light-giving power, as he had not tried; and it was impossible to answer such questions without experiment. He could not even say from his own knowledge that alumina would add to the strength, though he had heard so. He had tried the

addition of slight quantities of chrome to alumina, and was astonished at the effect produced; but he had not tested the effect of adding it to zirconia, and therefore preferred not to give an opinion upon it. He had found that mantles made from a combination of substances were better than those manufactured from any single substance; but he could not say whether this was common knowledge in 1885. It was probably first communicated to the world by Welsbach, that the substances he named would produce good incandescent mantles. He gave great latitude—too much, in his opinion—as regarded proportions and strengths, but not with reference to the substances to be used.

Re-examined: The object of qualitative analysis was to detect the presence of various substances, but not to estimate their quantity. It did not follow, because substances were thrown down in particular groups, that they were similar in character. Sulphuretted hydrogen was very often employed in analysis, because it threw down a number of metals which had the property of forming insoluble sulphides; but it did not at all follow that they were similar bodies.

Mr. JENKINS asked leave to recall Dr. Hehner, in order to prove an assertion which Mr. Bousfield had made in stating the result of the experiments with the recent sample of Mirck's nitrate of zirconia.

Justice WILLS said there was no use overloading the case with evidence on these abstruse chemical questions, which he felt himself quite unfitted to deal with. He could not see that they were material; and he must therefore refuse to hear any further evidence.

Mr. WALLACE then summed up the case for the defendants. In the first place, referring to the question of using ammonia, he thought he should not be justified in dealing with it at length, as it would take too much time. He would merely point to the evidence recently given that a practically pure specimen of Mirck's zirconia, so pure that no one would think it necessary to purify or wash it, would not make a mantle when treated with ammonia. The sample used by the plaintiffs' witnesses, with which they had been successful, was exceptionally pure—it only contained 0·4 per cent. of impurity. The next question was as to the alleged anticipations. They were only relied on as against the enlarged interpretation sought to be put upon the specification; not as invalidating the patent on any reasonable construction. They had been twitted with regard to one of the anticipations, that it covered too much ground. But it was important, as showing what information was in the possession of the public. A great deal of it might be irrelevant; but that which was relevant, must be taken to have been in the mind of the man who drew the claim in the specification in question. Mr. Moulton wished his Lordship to look at the infringement, and then construe the claim in the light of it.

Justice WILLS said he should certainly not do that. He should construe the specification first, and then see whether it had been infringed.

Mr. WALLACE (continuing) referred to the case of *Stevens v. Keating*, where it was stated that a claim to any materials which would answer was invalid. It could not be supposed that the draughtsman intended to make a bad claim; and therefore he must have meant to claim only the substances mentioned. *Spencer v. Jack* was another authority tending in the same direction. The question of the construction of this specification was what Lord Kelvin had described as an isoperimetrical problem.

Justice WILLS said that did not help him much.

Mr. WALLACE explained that a man drawing a claim was like one staking out a mining claim—he could fix his own limits, but he must not go beyond them when he had fixed them. It had been laid down again and again that Judges must not let their sympathy with an inventor run away with their judgment. Now, coming to the question of infringement, it could only be said that the defendants had infringed because they used zirconia, one of the substances mentioned by Welsbach. It was plain that lanthanum was an essential element in Welsbach, and that was not used; chromium being employed as the light-giving material. Alumina was also added to give strength; but this was only suggested as a partial alternative by Welsbach, for the purpose of strengthening the upper part of the mantle. Zirconia was well known, and had been used before. The real novelty in the defendants' mantle was the chrome, which Mr. Terrell had endeavoured to show, by his cross-examination, was one of the rare earths. This was, however, negatived by some portions of Mr. Moulton's opening, in which he said the chrome had no bearing on the question of infringement. The chrome was not only a substance of a different character, but it produced a different kind of light altogether. There was no direction in the patent that the chemicals should be absolutely pure; and though he did not seek to invalidate it on this ground, it was a fair conclusion that substances reasonably pure would do. It had afterwards been discovered that pure thorium had certain advantages; and they claimed that by itself as an invention. It had been held, in the case of Muntz's Metal Company, that the use of an absolutely pure substance was subject matter for a patent. Having commented on the change of front which had taken place in the course of the case, including the abandonment of the Haitinger patent, and the attempt to rely simply on the use of a rare earth, learned Counsel went on to deal with the question of the process of making the mantle; and he contended that the employment of ammonia was an essential part of the process—a part which the defendants omitted. It was obvious to him that the use of ammonia was specially introduced by the patentee for the purpose of producing the oxide skeleton; and when he afterwards discovered that the same ultimate result might be obtained in another manner, he in a subsequent patent for the first time stated that the ammonia might be dispensed with. The only remaining question was as to the proportions and strengths of solutions. It was admitted that the proportions were material; and it was not necessary to go into the evidence upon this point. He would therefore leave the case in his Lordship's hands.

Mr. JENKINS, who appeared separately for the last seven defendants, who were the subscribers to the Memorandum of Association, submitted that there was no case against them separately, and that they ought not to have been joined as defendants. The evidence showed that, immediately after the registration, they joined in appointing Directors; and thereupon they were *functi officio*, and were thenceforth merely shareholders. It might be that when the plaintiffs issued their writ they did not know who the Directors were; but although they were informed in March, 1895, they insisted on retaining these gentlemen as defendants. He submitted that this was wholly unjustifiable; and that these defendants were entitled to have the action dismissed as against them with costs. In the defence they put in, they did not impugn the plaintiffs' patent; and they said they did not threaten or intend to sell mantles of any kind.

Justice WILLS said he had told Mr. Moulton that he would allow him to reply on the morrow; and he might now remark that he did not wish to hear any further observations, except on the question of infringement.

Mr. TERRELL wished to say a few words on the question of equivalents; but he could hardly do so without in some degree touching on the question of infringement.

Justice WILLS pointed out he did not wish to limit Mr. Terrell unduly; but he could not have two general replies.

Mr. TERRELL said the submission of the plaintiffs was that the defendants had infringed, not literally, but in spirit; they had taken the pith and marrow of the invention. All the witnesses, he thought, were agreed as to what was common knowledge in 1885. It was known that all the substances in question here had certain properties. They were refractory, non-reducible, and capable of emitting light when highly heated. They were also pretty well agreed that the formation of the skeleton, by impregnating a fabric with a solution, and then burning out the organic material, was Welsbach's invention, and that this process was the pith and marrow of his patent. He then cited passages from *Clark v. Adie* and *Heath v. Unwin*, and contended that, as the process was the pith and marrow of the invention, and not the substances used, any material which was an equivalent, although not known as an equivalent at the time, would be an infringement. If the essence of the claim was the particular material used, the question of equivalents must be dealt with more strictly. He contended that the secret rare earth referred to in Professor Crookes's depositions was an equivalent for the substances mentioned in Welsbach.

Mr. BOUSFIELD said the substance referred to by Professor Crookes was not in the class of bodies to which it had been agreed the term rare earth in this case should be restricted.

Mr. TERRELL said he was entitled to call it a rare earth on the evidence of Professor Crookes.

Justice WILLS, after another protest by Mr. Bousfield, said if necessary he could open the sealed paper, and satisfy himself as to what the substance really was.

Mr. TERRELL said he would not pursue the point further. Unless a broad construction were put upon the specification, that the substances mentioned were merely words indicating the class of substances to be used, and that the real invention was the method of applying them for all commercial purposes, the patent might as well go into the fire. He did not care, therefore, to argue minute questions whether the claim must be confined to the actual substances named, or to things which would come within the general words of description employed. It was undoubtedly a patent for a combination; and in such cases patentees were not narrowly tied down to the exact words of the specification. The whole law of patents, he submitted, was contained in the proposition that one must discover what was the pith and marrow of the invention, and then find out whether it has been taken. He submitted, in conclusion, that the use of ammonia was an immaterial part of the process, which might be discarded without injury to the validity of the patent.

Mr. BOUSFIELD having offered a few comments on the various cases cited,

Mr. TERRELL said he had omitted to refer to Mr. Jenkins's argument on behalf of the individual defendants. He quoted one or two cases which showed that directors might be sued under such circumstances; and it was very important in the case of a limited company to know who were behind it.

Wednesday, April 1.

When the proceedings were resumed this morning,

Mr. MOULTON replied for the plaintiffs. He remarked at the outset that he had never known a patent exposed to so severe a trial as this; for not only was the original investigation as long and complete as could be, but there had been a second one on the top of the first—the defendants being closely allied, though without responsibility one for the other. The result was that the plaintiffs had had to defend themselves against inconsistent attacks. There was such a thing as overdoing a contest of this kind. And points which otherwise would have sunk into the relative obscurity which they deserved had, by reason of the length of the proceedings, been forced into prominence which they did not merit. He would now deal, in their proper relative importance, with the various questions which had arisen.

Justice WILLS said he had already intimated that he was perfectly satisfied as to the validity of the patent.

Mr. MOULTON said he understood that. He submitted that, if the English patent law was dominated by such principles as had been laid down in the speeches of Counsel for the defendants, it would be impossible to draw a specification which would secure an invention, unless it were so trivial that it deserved little reward at all. He did not think his Lordship would adopt such a view of the law as would lead to that conclusion. This was a highly-meritorious patent; and in accordance with the doctrines of the Court, it should be properly defined and broadly interpreted. They had gained only one thing from this double inquiry. Not one successful effort had been shown which did not use Welsbach's discovery—a coherent skeleton of oxides obtained by a solution of salts; the fabric afterwards being destroyed by heat. This was Welsbach's discovery, as was now admitted. The world had never gone back on that step; and every amendment of Welsbach's patent—whatever mantles had been made—had taken his method of making a coherent skeleton. Whatever the rights of Welsbach might be, unquestionably he had revolutionized the whole domain of incandescent lighting; and from that time, the question had simply been how far they could get from the actual words of his specification—still retaining the substance of the whole thing. It was beautifully illustrated in Dana, who said one could put another substance on the incandescent body, provided it

was not deleterious to it. There was no trace anywhere of a departure from the fundamental step which had made lighting by incandescence a practical possibility. This had been emphasized in the second case; and he could now speak, without fear of contradiction, of this being the great discovery made by Welsbach, which had caused a revolution in the whole domain of practical science. That being so, his first duty was to take the patent, and see what was claimed; and then, secondly, to see what the defendants had done. It would then be for his Lordship to decide whether the defendants had taken the substance of Welsbach's discovery. But he would first deal with the argument that, because at the date of the patent there was not the knowledge that lanthanum by itself, or zirconia by itself, would make a coherent skeleton, therefore the patent did not cover the use of these two substances. There was no doctrine in the English patent law that, if it required experiment or invention to ascertain that something would do instead of what was put into the patent, it was outside the patent. How, if it were so, would it be possible to have an important patent? Nine out of ten patents were for improvements of earlier inventions—improvements that had been the result of experiment, investigation, and invention. But who ever heard that it was an objection to these coming within the fundamental patent, that it required experiment and invention to discover a subordinate patent? He might give cases in which it was certainly negatived. Look at Hunning's transmitter—coke dust with platinum foil put over it. No one reading Edison's patent, with the knowledge of that time, would have known they could effect the transmission of sound by so simple a means; but the Court nevertheless held that they had used the substance of Edison's discovery in this marvellously changed form.

Justice WILLS: The work of the infringer is oftentimes a process of very considerable ingenuity. He makes a great many experiments to see how near he can get to the patent, or how he can do the same thing, and yet appear not to do it.

Mr. MOULTON said that was exactly his point. The same remark might be applied to the other argument put forward—that perhaps zirconium might not have done; and if so, the plaintiffs' patent would be bad. He submitted that the duty of a patentee was to make the invention, and inform the public how to do it. It was not his business to tell the public how near they might go to failure, and yet succeed. His part was to mark out the road, and to say: "This is the middle of the road, and you had better keep there." The infringer's endeavour was to go as near the edge of the road as he could without falling over. It was not the business of the patentee to show how far infringers might vary and yet keep the substance of the invention. How could a man who had made an invention be so master of it as to tell what the world, within the next ten or twelve years, would be able to do in the way of employing the knowledge he had given, using it with the broader knowledge of those years, so that things he had thought indispensable might be dispensed with, and difficulties be got rid of in ways not known to him? The infringer set to work, knowing what was the pith and marrow of the patent; and, having plenty of time, he could proceed at his leisure, and day by day decrease the resemblance. Infringers often had great ingenuity, and even powers of invention; but here the question was one of fact. Had they really achieved success by using what was the pith and marrow of the invention? Could anyone who had heard the case doubt that there was no one infringer who had ventured to move from that which was Welsbach's great achievement—the making of this marvellous skeleton by using a solution of salts to impregnate a fabric? They varied only in the choice of that with which they made their skeleton; and they did not go very far even in this respect. Welsbach's specification was startling in the extent to which he had told the world where they must look for the material for possible incandescent mantles. It was most remarkable that, in the second case, Dr. Hehner said the best way of making the mantles the defendants used was to take zirconium and alumina—two of the substances mentioned in the patent of 1885—and then to spray a small amount of chrome upon it. They had realized how necessary it was to use Welsbach's method of making the mantle; and then they tried to get out of the patent by putting in things which made it appear that they were not using the substances Welsbach had referred to. Reviewing the evidence of Professor Crookes and Sir Henry Roscoe, he submitted that it was an infringement to vary the substances while using the method; taking those that turned out well, and rejecting those that resulted poorly.

Justice WILLS asked what the Courts of Law meant by "taking the pith of a man's invention?" Did they mean anything but the pith of the actual claim? Incidentally connected with that, was a question which he thought this case, when it got to the House of Lords, must clear up one way or the other—whether, when the patentee himself evidently thought a particular thing extremely important, and it turned out that it was not, they could deny that it was still part, and a very essential part, of the substance of his patent. It was difficult to escape the conclusion that in the specification importance was attached to lanthanum. Whatever might be varied, they must stick to lanthanum.

Mr. MOULTON: Or zirconium.

Justice WILLS: Either. It turned out that defendants found they could do without it, for apparently there was no lanthanum in thorium; and it would look as if lanthanum did not possess in reality the importance which the patentee thought it did. Was he (the learned Judge) at liberty, in considering what the "pith" was, to regard what the patentee thought obviously of great importance, as of none or very little importance.

Mr. MOULTON replied that he did not ask his Lordship to say it was of little importance, but to say that, taking the invention as a whole, the omission of this material still left the substance of the invention. He might have an inferior article; or he might have used something instead, which was equivalent.

Justice WILLS said, apparently, as far as the evidence went, the only effect of leaving out the lanthanum was to diminish the value of the article produced.

Mr. MOULTON cited Lord Cairns, to show that one might be outside the words of the claim, and yet infringe it. They had to consider what was the real invention, in order to see what was the pith and marrow of it; and for this purpose, they were bound to consider the state of public knowledge, and the step that was taken. Reverting to Lord Cairns's illustration, if they took the words of a claim: "We claim A. B. C.," and looked at A. in blinkers, and at nothing else, it was impossible to say that B. and C. were infringements, because the claim was for the combination A. B. and C.

Justice WILLS: Where you have in a patent a correlation of A. B. C., and it does not say in words that one is more important than another, you must, it seems to me, rely on external evidence to show whether it is only what is called a small variation; because nobody can tell, reading the patent, whether it is small or large. But suppose the patentee had gone farther, and had said: "Whatever else in my invention you may fairly play with, you cannot play with A;" and then it is found that A. can be dispensed with?

Mr. MOULTON suggested that one could not draw that inference, simply because he had put no alternative to A. The whole problem here was, how to create a skeleton of refractory oxides—what refractory oxides to choose; and he gave a lot to select from. Looking at the whole history, he asked his Lordship to say that by far the greatest part of the invention was the discovery of the way to make a skeleton of resistant oxides, of enormous surface and infinitesimal weight, and with the power of standing this great heat.

Justice WILLS said alumina alone made an excellent mantle in all these respects; but it would not produce any light. Therefore the two things were equally important. He could not take the view Mr. Justice Wright seemed to have adopted, that the process here was subordinate. He thought it was of the highest possible consequence; but it seemed to him the rest of the patent was of very great consequence also.

Mr. MOULTON (continuing) referred to what he thought was the only case which would compare with this—*United Telephone Company v. Harrison, Cox, Walker, and Co.* Edison's patent was full of the most ingenious devices—the diaphragm moving backwards and forwards, and the tension regulator behind. The inventor had great difficulties to surmount; and it was natural he should not at the time be able to see what was, and what was not important. Inferior people might afterwards show the true relative importance, taking advantage of his knowledge. But it would be very hard on an inventor if he was to be limited strictly by his opinion and imperfect knowledge at the time, as to the extent of the claim. In Nobel's case—which was very remarkable—the inventor had limited himself to "soluble" nitro-cellulose; and the Courts held that he had taken special pains to exclude the "insoluble" variety. Had he not from beginning to end restricted himself to "soluble," but simply said "nitro-cellulose," it would have been held to include both varieties. In the present case, it was emphasized as clearly as possible that what was claimed was the "manufactured appliance."

Justice WILLS: I want to know exactly what is meant by "manufactured" in this connection?

Mr. MOULTON: The method of producing "substantially as herein described." These words generally at the end of a claim followed immediately after the word "manufactured." If it had been "the use of lanthanum," or "the use of zirconium in incandescent mantles," or "for the purpose of giving out light," it would have been parallel to Nobel's, though not quite so strong. The patentee claimed "the manufacture, as herein described, of illuminant appliances for gas and other burners." It was the novel mode of getting the appliances which he put forward and which he claimed; and looking at the state of public knowledge, nothing of this type had been made. He granted that, if they took the year after, and looked at these mantles and the appliances that existed, the man who drew that up and was aware of the state of public knowledge, knew that appliances existed. But apply that to this claim. The man who drafted it, knew that no appliances of the same type ever existed; they were novelties, and he claimed them as his invention. What a different position that gave to this patent from any subsequent ones. The fundamental part was the new process of manufacturing illuminant appliances, "consisting of a cap or hood made of fabric impregnated with the substances mentioned, and so treated as set forth." "Treated," of course, means burned off. He said "substances mentioned," not "compounds I have referred to." The broadest and vaguest language was used, because the substance of the invention was this mode of manufacture. The defendants said they took some of the substances, though not the ones advised; but they had not taken one which this specification did not say could be adopted and put into the mantle. "Impregnated with substances," did not mean in special proportions.

Justice WILLS: It is not shown that any of these substances taken alone would not cohere.

Mr. MOULTON said the coherence arose from the fact that they started with impregnation, and the heat reduced the salts to oxides. That was the great step which lay at the bottom of every successful infringement and every attempt at incandescent light.

Justice WILLS supposed he might take it that it had not been shown that any particular blend of substances would fail.

Mr. MOULTON said that was so. He was therefore entitled to say that Welsbach in his claim did emphasize the pith and marrow of his invention.

Justice WILLS said the learned Counsel was entitled to whatever measure of protection the law, as illustrated by *Proctor v. Bennis*, gave him for what Lord Justice Bowen called "pioneer invention." But the measure of increased protection indicated there was very scanty. The point was referred to in the ticket-punch case; and Lord Justice Smith seemed to bring it to this: If it was a new combination—a new prescription, as it were—producing an old result, if it was a physician's prescription for an aperient powder, they were tied by what was stated there; but if it was a new thing altogether, as he thought it was here, they were entitled to the benefit of mechanical equivalents.

Mr. MOULTON thought the doctrine of mechanical equivalents was a good deal misunderstood. When they looked at the whole step taken, and the whole infringement, was the step from darkness to light the same in the one as in the other? He felt in this case it was so much a question of substance, that no jury would hesitate to say: "That is Welsbach's; but he has dropped out one of the substances."

Justice WILLS: Would it be a misdirection to leave to a jury the question of infringement, without telling them that the omission of ammonia and lanthanum prevented it being an infringement?

Mr. MOULTON thought certainly not.

Justice WILLS said it might be open in such a case to go to the Court of Appeal and say the verdict was against the weight of evidence; but that was another thing.

Mr. MOULTON remarked that he had not said a word about the non-user of ammonia, because it was an example of the disadvantage of having two packs of hounds at the same stag. The first evidence taken in this series of cases was that of Professor Crookes; and in spite of his (Mr. Moulton's) protestations, he was asked, as a chemist, was the ammonia important? The witness said: "I shall answer that the wrong way, if I did not say that it was." He thought Dr. Hehner threw light on this. He said the patentee did it because he was afraid the nitric acid would rot the fabric.

Justice WILLS thought the evidence as to ammonia was this: The attack was not that ammonia did mischief in other respects, but it was fatal to the process; and if this had been established, it would be an end of the battle. But one of the plaintiffs' witnesses said that the ammoniated mantles were slightly stronger than the others.

Mr. MOULTON (continuing) said the amount of ammoniation was a matter of judgment. There was not the slightest doubt any sensible chemist would see that if he chose to work with a very acid nitrate, it would be wiser to use ammonia; and if he employed a basic nitrate, it would be unnecessary. Welsbach gave a proportion which would be very useful. It was not for the patentee to tell others how to end in failure, but how to succeed, taking the knowledge of the patentee and the world at the time. If infringers were to make experiments to see how they could vary the invention and yet get the same results, the remedy was not to be sought in ingenious claims or in verbiage—seeking to catch the future infringer by ringing the changes on what they might consider a part of their invention—but by putting a clear claim to their invention; and the Court would not allow it to be pirated, because the infringer had not come exactly within the language of the specification. Coming then to the Sunlight mantles, the learned Counsel said the chrome neither made nor marred the infringement; and he did not rely on it. Chrome was a resistant oxide, and capable, therefore, of making a good light by means of incandescence. If it could be properly placed on a suitable body, it would make a mantle. He did not care what they used plaintiffs' mantles for—they might use them as the basis of future and greater successes; and they would be entitled to a patent for such successes. But they could not employ the plaintiffs' mantles without infringing their patent; and by that he meant mantles made of such things as zirconia, and strengthened with alumina. They took as their basis a mantle made substantially according to the substance of the plaintiffs' patent. The infringement was there; but they had departed so far from the plaintiffs' blends, that it had poor light-giving qualities. They reinforced it by something they got themselves; but they had their basis in plaintiffs' patent. Having referred to the case of the *North British Rubber Company v. Macintosh*, he asked his Lordship to look at the patent in the broadest sense, and to hold that it did not tie them to particular blends; and that by varying the exact mode in which they mixed the substances, the infringer had not got outside the patent. He did not deal with the minor blends; but he submitted that his clients were entitled to a verdict in both cases.

Mr. BOUSFIELD added a few words with regard to the "ticket-punch" case and the *North British Rubber Company v. Macintosh*, which concluded the arguments.

Judgment was reserved.

WEST HAM POLICE COURT.—Monday, March 30.

(*Before Mr.* E. BAGGALLAY.)

The Supply of Gas by Automatic Prepayment Meters.

Mr. *F. Newton*, a bird dealer, of 306, Victoria Dock Road, Custom House, was summoned to-day, at the instance of The Gaslight and Coke Company, for £1 2s. 7d. for gas supplied to his premises. The case presented some important points in regard to the supply of gas through automatic prepayment meters.

Mr. HUMPHREYS appeared for the Company; Mr. F. GEORGE represented the defendant.

The facts of the case were as follows: Mr. Newton had on his premises an automatic prepayment meter, of which there are about 4000 in use in West Ham. From one to fourteen pennies could be put into the meter; and 25 cubic feet of gas would be registered for each penny. When these meters are supplied, a special agreement is signed by the consumer and an agent of the Company. By this the consumer agrees to pay at the current price per 1000 cubic feet of gas "as registered by the automatic meter," and also to pay, "as rent for the use of the gas-fittings, such extra sum per 1000 cubic feet as shall 'with the price of the gas' make up an aggregate rate per 1000 cubic feet of 3s. 4d." Then at the foot of the signed agreement is a note which sets forth that the meter, fittings, burners, or cooking-stoves remain the property of the Company, and that there are penalties for disconnection or removal. "In case of any defect in the automatic arrangement of the meter," the notice continues, "whereby gas passes without prepayment, or by which an incorrect quantity is given for a penny, the consumer will be charged by the meter index," which registers all the gas that passes through the meter whether pennies are put in the slot or not. The defendant's meter was examined from time to time; the coins put into the slot being found to correspond with the quantity of gas consumed, as shown by the index. But on Oct. 28 last it was found that 6000 cubic feet of gas had been consumed since the previous visit; and instead of £1 being in the money-box, there was only 8s. 10d. A new meter was sent on Nov. 15; and when, on Nov. 22, the old one was again checked, there were but four pennies in the box, while the consumption, as registered by the index, gave the calculation that 11s. 9d. should be in the meter. Mrs. Newton was spoken to about the matter; and her reply was that they had put pennies in the slot when the gas supply ceased; and if they had burned more gas than they ought to have done, it was the Company's look-out. The automatic arrangement, when it was examined, was found to be defective—the valve, when once opened, remaining open long after its "automatic 25 cubic feet" had passed through. As the defendant refused to pay the £1 2s. 7d. alleged to be due from him, his gas was cut off on the 27th of January last, and the present proceedings were instituted.

Mr. HUMPHREYS said the questions to be decided were important to gas consumers as well as to the Company; and if the matter were well threshed out, time and trouble would be saved in the future.

Mr. GEORGE raised a number of points. The current price of gas, he said, being 2s. 10d. per 1000 cubic feet, 6d. for each 1000 cubic feet burned was charged for the fittings; and this was secured by a special agreement with the consumer. The contract, he submitted, would be held to mean what was understood by the parties—viz., that if a penny were put in, 25 cubic feet of gas would be consumed; and the Company, entering into a contract to supply gas at a price above the current rate, contracted themselves out of their remedy at that Court.

Mr. BAGGALLAY: Section 23 of the Gas-Works Clauses Act, 1871, makes the recovery by this procedure.

Mr. GEORGE: For a supply under the General Act, yes; but if the Company go out of their way to give a special supply like this, or to (say) a balloon, it would be a civil contract, and would not come within the Act. If the price of gas alters, then this charge for fittings will be a fluctuating one.

Mr. HUMPHREYS: In the event of an alteration in the current price, we should so regulate the supply of gas that no more than 6d. per 1000 cubic feet would be exacted.

Mr. GEORGE: The clause is so drafted that, whatever is the current price of gas, the Company gets 3s. 4d. per 1000 cubic feet; and my point is that they cannot blow hot and cold—they have contracted themselves out of the Act.

Mr. BAGGALLAY: What occurs to me is that this summons is not for the price of gas alone, but for gas and the use of fittings—not for the use of a meter. Does the Act give the Company power to summon a man in the Police Court for fittings?

Mr. GEORGE: I think so; there is section 40.

Mr. BAGGALLAY: Section 23 only relates to procedure for the recovery of the supply of gas; and section 40 only refers to the rent of the meter.

Mr. GEORGE: The consumer is entitled to rely on the automatic arrangement being correct. If it goes wrong, it is no fault of his.

Mr. BAGGALLAY: It is quite clear that the defendant consumed more gas than he paid for. But there are two questions—first, whether the Company are entitled to recover by this procedure; and, secondly, whether the Company, by supplying this automatic arrangement, do not make themselves responsible that it shall work. On these two questions, I shall reserve my judgment. On the other points, I should like to have it on the notes what the word "fittings" comprises.

Mr. *H. S. Nicholls* was called, and said the fittings included three pendants in the shop and one in the kitchen, and a cooking-stove.

Mr. HUMPHREYS added that they included pipes that ran through the house.

Mr. BAGGALLAY: It does not include the gas-meter?

Mr. HUMPHREYS: No; we have not charged for the meters for a year and a half.

The case was then adjourned, his Worship suggesting that, in the meantime, this being a test case, the defendant should be supplied with gas. If he were given a "working" meter, he could not burn more than 25 cubic feet of gas for his penny.

Bolton Corporation Water-Works.—The Water Committee of the Bolton Corporation have ordered an application to the Local Government Board for their sanction to the borrowing of £15,290 for the purchase of lands forming part of the watershed area of the Entwistle reservoir.

Waste of Water at Batley.—A few years ago, the prevalence of lead-poisoning at Batley caused the then Medical Officer (the late Dr. Swann) to advise consumers supplied through leaden service-pipes to run off a quantity of water in the early morning before using any for domestic purposes. This advice has been acted upon so liberally, that the Water Committee of the Corporation have been compelled to appeal to users to be as careful as possible. So enormous is the waste, that a Water-Fittings Inspector has been appointed to help in putting a stop to it; and certain consumers have been summoned before the Committee and reprimanded. Future offenders, however, are to be taken before a Magistrate. It is pointed out that a run of 20 or 30 seconds is amply sufficient to empty pipes of all water standing in them; and thus secure partial protection. Absolute protection could only, of course, be obtained by the substitution of service-pipes made of some other material than lead.

Gas Affairs at Dorking.—At the recent half-yearly meeting of the Dorking Gas Company, the Directors reported that a balance of £2474 was available for distribution; and they recommended dividends at the rate of 10 per cent. on the "A" and "B" shares, and 7 per cent. on the "C" shares, also 3s. on "A" and 2s. on "B" shares, on account of arrears of dividends. After making these payments, a balance of £1577 would remain to be carried forward. These results had been obtained with the net price of gas at 3s. 9d., as compared with 4s. 2d. in the corresponding period of 1894; the lower price having led, as was anticipated, to an increased sale of gas. In the course of the proceedings, the Chairman (Mr. J. Young) remarked that, though the report was satisfactory to the shareholders, it was apparently hardly so to the District Council. As usual, they seemed somewhat aggrieved, though he was afraid they really did not know of what their grievance consisted. The Company had done all they could to elicit what improvements were considered necessary. The Directors long ago suggested an expert; and the Council refused, on account of the expense. Now they had come to the conclusion that an expert was advisable. He thought this would be particularly to the benefit of the Company, because it would be the means of giving more general satisfaction to all. The Council had always had the power of sending a gas examiner to test the gas; but the Company had not been troubled with this gentleman for years. The report was adopted.

MISCELLANEOUS NEWS.

COMMERCIAL GAS COMPANY.

The Ordinary Half-Yearly General Meeting of this Company was held on Thursday, at the Cannon Street Hotel—Mr. J. BLACKET GILL in the chair.

The SECRETARY (Mr. H. D. Ellis) read the notice convening the meeting; and the half-yearly report and accounts, which were published last week, were afterwards taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said he thought the proprietors would consider the latter fairly satisfactory, though in one case they could have wished for better results. He did not propose to trouble the meeting with a lengthened speech, or to go through a mass of figures; but he would glance at two or three salient points which might be of interest. First their coals had cost £2000 more, and the carbonizing wages £1000 more than in the corresponding half of 1894, which was due to the larger quantity of coal carbonized. Rates and taxes had increased by £80; and as they now paid £6457 in the half year, he thought the proprietors would consider them quite high enough. Bad debts were £109 less. Taking into consideration their very poor district, he regarded this as highly satisfactory; and it showed that their collectors had done their work well. On the other side of the account, they had received £1186 less for gas, notwithstanding that they had had an increase of 2 per cent. But this compared with a half year when they were charging more for gas; and it accounted for the loss. The increase was rather small in comparison with their two neighbours. But, as he had mentioned before, their district was a very poor one; and so they must be thankful for small mercies. The coin meters (which were such a great boon to working people) showed an increase of £270; and they now numbered 2784 in the district. The stove-hire had increased by £68; and they had 5076 stoves in use. The residuals, coke and breeze, exhibited a decrease of £2447; and the receipts from sulphate of ammonia were less by £3964. Inasmuch as they had a gain from tar of £826, the total diminution on the residuals was £5585. The result was that it had cost them £133,607 to earn £176,613—leaving £43,006 to carry to profit and loss. This was not quite sufficient to pay the dividend. The Directors therefore proposed to take from the balance of undivided profit sufficient to make up the sum required; and they would then have £15,115 to carry forward. They were adopting the same course as last year in not declaring the full statutory dividend of 13¾ and 10¾ per cent.; and they proposed that 13½ and 10½ should be paid, and the other ¼ per cent. added to the reserve fund. This was a proceeding he was sure the proprietors would approve, as the amount placed to reserve would come in to help them on future occasions. The most disagreeable feature connected with the accounts was the decrease in the receipts from residuals. It was not his province, nor did he wish, to criticize in any way the action of their very large neighbour. But the proprietors would well understand that any policy pursued by them must re-act to a great extent on the Commercial Company. It had been their policy to accumulate very large stocks of coke and sulphate, rather than sell on what they considered was a falling market. Whether this was wise or not, he was not going to discuss; but when their neighbours had a vast quantity of coke stocked at Beckton, it must necessarily affect the price the Commercial Company could get for theirs. Then, again, with sulphate, they had accumulated large stocks of sulphate; and the market had been dreadfully depressed. Looking back at the price paid for this product, he found that, in their own case, they received in 1872 no less than £21 a ton. But it had since dropped until in 1894 the average was £13, and in the past year it came down to between £8 and £9. There were three things to account for this. In the first place, agricultural depression, which was rife abroad even as it was in this country. Secondly, the increased make—all works producing more than they had hitherto done. The third cause was the lower price of nitrate. The production was thus really in excess of the demand; and this no doubt accounted for the depression in this particular article of trade. It was hazardous to predict as to the future; but he believed, and competent judges believed, that sulphate was now as low as it could possibly come to. They therefore hoped they would get better prices in this half year. It would be noticed that there had been employed a considerable quantity of oil for enrichment; but they had not this year used so much by a good deal, as they had gone back to some extent to cannel. The reason for this was that the Standard Oil Company, who controlled the petroleum market, put the price up to a considerable figure. There was consequently a difficulty in obtaining it at the price they had been paying for it; and so their Engineer (Mr. H. E. Jones) had relied more upon cannel. In speaking of this matter, he could not help alluding to the terrible waste of money that went on in London in connection with the gas supply. Most of the cities on the Continent were content with 12 or 13 candle gas; and anyone walking about these cities would notice that they were not one whit inferior to London in the matter of lighting. The cost of the enrichment of gas by the London Companies was something immense; and if they could only have relief, and supply the public with gas of 12 or 13 candle power, the price could be put down largely to the consumers. But any improvement started by the Gas Companies was always looked upon askance by people—they always thought that there was something beneath it; and that the Companies were doing it for their own benefit. Their own day consumption amounted to about a quarter of the whole consumption; and they were positively producing gas of this high illuminating power to cook and boil workmen's dinners. If the consumers would only understand that they were partners with the Company under the sliding-scale, and that the advantage would be greatly on their side (because the public obtained about four-fifths in comparison with the Company's one-fifth), then some improvement might be effected; and it would save their own Engineer and other engineers from that which was the great bane and worry of their lives—the keeping up of this high illuminating quality of the gas. But the Companies were tightly bound by their Acts of Parliament; and they must therefore go on as they were doing now. He, however, made these remarks in the hope that some day an improvement would be effected, which would be a boon alike to the Companies and the public. Their works had been well maintained during the past year; and a considerable sum had been laid out on them. They had built a new stove-shop; and a new purifying-house had been erected at Wapping. The works were generally in a thorough state of good order. He would allude to one domestic matter in conclusion. They had had the misfortune to lose a member of the Board (Mr. Farnan), who was with them for a good many years. He was always attentive to his duties; and he endeavoured to promote the interests of the Company to the best of his ability. To fill the place vacated by Mr. Farnan, they had elected Mr. Besley, who had time at his disposal (having relinquished some of the labours of his profession), and who was prepared to give them the benefit of his advice. He (the Chairman) was sure the proprietors would gladly endorse what the Directors had done. Looking forward to the future, he might say the Company were sound and healthy in every possible way; and it was really only the question of the residuals which might probably interfere with the production of quite such a good report as they could wish for.

The DEPUTY-CHAIRMAN (Mr. W. G. Bradshaw) formally seconded the motion.

Mr. GEORGE LIVESEY said he did not often intervene in that room; but he felt the sympathy of the proprietors was certainly due to the Directors under the very difficult circumstances in which they were placed in managing the concern at the present time. The proprietors had listened with very much interest to the clear and straightforward statement of the Chairman as to the question of the residual products; and it had also been a great satisfaction to him (Mr. Livesey), at any rate, to hear what the Chairman had said in regard to the subject of the illuminating power of gas. The London Gas Companies—in fact, gas companies throughout the United Kingdom almost—were being forced by Parliament to supply gas of a higher illuminating power than was obtainable from the available coal supply; and this of necessity meant that the consumers had to pay a good deal more for the extra quality than it was really worth. The general impression seemed to be that everything that could be screwed out of gas companies came out of their pockets, which was a total fallacy. Five-sixths came from the consumers. The consumers had to pay this extra cost for the higher quality of gas; and with regard to a very large proportion of the gas this was an absolute loss to them, while to those who used it for the purpose of lighting it was of no practical benefit. Much fuss was made about an extra candle or half candle. Yet the consumer, by using an inferior burner, would often lose 6 candles—that was to say, his 16-candle gas was reduced to 10-candle, or even less; while with the new burners he could increase the value obtained from the gas consumed to 25 or even more candles. His idea was that the gas companies could very well say to the authorities: "Any saving that we may effect by the reduction of the illuminating power, we are willing to give to the public. They get five-sixths now; we will give up our one-sixth, or whatever it may be." So that any saving that might be effected should all be taken by the public; and this ought to show them that gas companies were not such grasping monopolists as people thought them. He had one or two more remarks to make; and he was sure the Directors would take them in good part. He thought they might be heartily congratulated in not having laid out money in experiments with carbonizing machinery. There were plenty of companies—the larger companies—who could better afford to do that. They had spent money in this direction; and in many cases, the machinery had had to be entirely renewed—it had not been found fit for the purpose. But he thought they had now a type of machine which was well fitted for carbonizing their caking coals; and he would suggest whether the time had not arrived for the Commercial Company to do what they could in the use of machinery for carbonizing. The carbonizing wages, which before the advent of the Gas Workers' Union, were about 2s. 6d. per ton of coal, were now he said 3s. 5d. per ton. But all these improvements meant the spending of money; and it would be necessary to raise capital. He saw that the Company had "come to the end of their tether," so to speak; they had practically no working capital, and were in debt to their bankers to the extent of £60,000. He thought he could read between the lines here. He fancied he could see that they were chary in spending money, because the capital had to be raised at so high a rate. Whereas all gas companies who were raising their capital under the auction clauses were getting it at something not exceeding 4 per cent., it cost the Commercial Company 10½ per cent. It was all very well to look at this from a shareholder's narrow point of view; but what they had to do was to regard it from the broad view of the general welfare of the Company. And the fact that the Commercial Company obtained their new capital without the auction clauses was now proving a disadvantage to the Company. It would be decidedly to their welfare if they could issue the new capital by auction or tender, and so raise money whenever they wanted further extensions, at a low rate of interest. They would then be placed in a better position for extending the business. The proprietors would say: "We are entitled to these allotments at par." But the proprietors would notice that the allotments came at long intervals; they were few and far between. He believed this was explained by the fact that the Company could not afford the high rate they were paying. For his own part, he thought he would go to Parliament to cancel the power to issue the stock at par, and ask for power to raise capital under the auction clauses, because he was satisfied that, by so doing, it would ultimately benefit the Company and the proprietors.

The CHAIRMAN said they were very pleased indeed to see Mr. Livesey among them; and they always listened to his remarks with the greatest interest. He had really said what passed through his (the Chairman's) own mind as to the raising of fresh capital; but, as the Engineer reminded him, they had only had a 12 per cent. increase in the last ten years. They did not move at the pace Mr. Livesey did; nor did they get money in the same happy fashion. He did not suppose that all their 1200 or 1300 shareholders would feel so philanthropically inclined——[Mr. LIVESEY: Not philanthropy; good business.] Their stock was fetching a high premium in the market; and he was afraid

there would be some opposition. It was hampering their Engineer to some extent, that his neighbours were making large extensions and improvements, and getting the money at a cheap rate, while they were obliged to raise capital at 10½ per cent. The time must come when new capital would have to be raised; and the Directors would certainly bear in mind what Mr. Livesey had said upon the matter.

A PROPRIETOR inquired what effect the incandescent light was having upon the consumption of gas. He said that the Incandescent Gas-Light Company stated that, by means of their mantles, the consumption was reduced by 50 per cent.

The CHAIRMAN replied that the incandescent burner was really of great assistance to gas companies. It reduced the consumption by about 33 per cent.; and it was a saving and a great advantage. He knew of cases on the Continent where the incandescent burners had prevented the loss of large customers, who would otherwise have gone in for electricity.

The motion was then unanimously carried.

On the proposition of the CHAIRMAN, seconded by the DEPUTY-CHAIRMAN, dividends were declared at the rates of 13½ per cent. per annum on the old stock, and 10½ per cent. per annum on the new stock, both less income-tax.

The DEPUTY-CHAIRMAN, in moving the re-election of the retiring Directors—the Chairman and Messrs. W. Hunter and E. T. E. Besley—stated that Mr. Gill had been a Director of the Company for 23 years; and for some years he was a Director of the Ratcliff Company, which was amalgamated with the Commercial in 1875. Mr. Gill had been Chairman since 1889; and his colleagues could testify how ably he had steered the Company through the troublous times that followed. The Deputy-Chairman also referred to the value of the services of Messrs. Hunter and Besley, and to the loss of Mr. Farnan.

Mr. G. ENNIS seconded the proposition, which was unanimously agreed to.

The CHAIRMAN having briefly replied for himself and his colleagues,

The retiring Auditor (Mr. J. Haigh) was re-appointed.

On the motion of Mr. LIVESEY, seconded by Mr. CECIL, a resolution was passed thanking the Directors for their services, and expressing the continued confidence of the shareholders in them.

The CHAIRMAN, having responded, moved a similar compliment to the Engineer, Secretary, Accountant (Mr. Favatt), and the Sub-Engineers. He highly praised the work of the Engineer and the Secretary. As to the Accountant, he said that Mr. Nash, who had filled the office for 33 years, had retired; and the Directors had placed Mr. Favatt in the position. Forty years ago, Mr. Favatt became connected with the Ratcliff Gas Company as a clerk in the office; and, by close attention to his duties, he had now attained the honourable post of Accountant to the Commercial Company. He mentioned this, because it was well for those in their employ to know that, if they did their duty, there was a chance for them.

The motion was heartily agreed to.

The ENGINEER, having expressed his great appreciation of the vote, remarked that Mr. Livesey, with his shrewd mind, had certainly put the lance straight through the point, which was one of difficulty and of some moment to himself. The Chairman had shown how well he understood the benefit derived by the consumers from any saving effected; and Mr. Livesey had shown how very saving the Company must be with their capital, because of the high price they had to pay for it. Mr. Livesey had spoken about the introduction of machinery. He (Mr. Jones) was no foe to machinery; he was no foe to progress. But he was distinctly a warm friend to keeping down the capital account of the Company. It was his boast that, though all the capital cost them 10½ per cent., it formed no larger burden upon the cost of gas than in the case of those companies who obtained capital at 4 per cent. He claimed the credit (this had been roused by what had been discussed) that, even with this heavy burden, the capital had been so prudently spent by his late lamented father and himself, that the proprietors had the firuit of it; and they could walk off with these large dividends with the consciousness that they were not putting any burden upon the consumers of gas. The dividend of the Company was one of the smallest charges for the same purpose of any gas company in England; and they could not produce this condition of things if they spent their money in experimenting with machinery and other things. The introduction of machinery involved the reconstruction of buildings, which, until they were worn out, he was unwilling to reconstruct for the purpose of making experiments. At their works, they were cramped for room; but at their most favourable riverside station they were putting up carbonizing plant which could only be charged by hydraulic machinery. He had seen enormous sums spent on these machines; and he was far from thinking they were perfect yet. But when the Company had some at work, they might see their way to improving them further. He had looked longingly at many labour-saving appliances; and if he could find capital at 4 per cent., he should be glad to introduce some at once. When he was getting a 5 per cent. increase per annum, instead of 1 or 2 per cent., he might add 5 or 6 per cent. to the capital, and acquire these appliances, and yet give the shareholders their 10½ per cent. dividend. Being a shareholder as well as their Manager, he did see the other side of the medal; and he trusted he might be able to carry this out, and get the proprietors their allotments without putting them up to auction.

The SECRETARY also responded; and the proceedings terminated.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday—Mr. E. FOTTRELL, J.P., in the chair.

The SECRETARY and MANAGER (Mr. W. F. Cotton, J.P.) having read the notice convening the meeting, the report of the Directors, an abstract of which appeared in the "JOURNAL" last week, was taken as read.

The CHAIRMAN, in moving the adoption of the report, remarked that the accounts which had been submitted to the proprietors showed satisfactory results on the past half-year's working, as compared with the corresponding period of 1894. They had carbonized 1507 tons more coal; and the gas sold produced an increase of £4300. This was due to the very dark days in November and December, when the quantity of gas used for illuminating purposes was very large. There had been an augumented consumption both for cooking and manufacturing purposes. The placing also of automatic meters had not made so much progress as he could wish, not bearing favourable contrast with towns in England. However, he had no doubt that, when the system was better known, the demand would increase. They had sent out about 700 meters of this class. Under the head of residuals (coke and sulphate), he regretted to say there was the serious diminution of £5189. This was chiefly owing to the very large reduction in the price of sulphate, which had fallen in twelve months to the extent of about 50 per cent.; and he was not in a position to hold out hopes of an immediate recovery. All gas companies had suffered in this respect. The receipts for tar showed an increase of £1300. As regarded the appropriation of the balance, the Directors, he considered, were showing discretion in placing £2500 to the contingent account, and bringing forward a balance of £5228 to the current half year. As the price of gas had been reduced 2d. per 1000 cubic feet from the beginning of the year, it would necessarily cause a considerable decrease in the gas-rental; the 2d. per 1000 cubic feet representing about £10,500 per annum. It was well to have this balance to fall back upon. As stated in the report, the Corporation were promoting a Bill in Parliament which contained clauses that would (if passed into law) injuriously affect the Company—in fact, clauses such as no gas company had been placed under. They would tend to a confiscation of the Company's property; and therefore the Directors felt they must strenuously oppose the Bill.

Mr. J. R. WIGHAM, J.P., seconded the motion; and it was carried.

The CHAIRMAN next proposed dividends at the rates of 10½ and 7½ per cent. on the old and new shares respectively; and the proposition was agreed to.

The retiring Directors and Auditor were re-elected; and votes of thanks were accorded to the Chairman, Directors, and officers.

EAST LONDON WATER-WORKS COMPANY.

The Half-Yearly General Assembly of the Proprietors was held at the Company's offices, St. Helen's Place, Bishopsgate Street, E.C., on Thursday last, under the presidency of Mr. GEORGE BANBURY.

The SECRETARY (Mr. I. A. Crookenden) read the notice calling the meeting; and the report of the Directors was taken as read.

The CHAIRMAN stated that the increase in revenue during the past half year, when compared with that of the corresponding period of 1894, had been £4024, which, added to that of the first six months, brought up the total increase for the year 1895 to £9500. This proved that there was nothing like retrogression in the conduct of their business. They were, in fact, progressing very well. They had laid on supplies to 2500 houses, four-fifths of which were outside the Metropolitan area. The income derived from these new tenements averaged only £1 7s. 2d. each, which, however, was 1s. 9d. per house higher than the average during the preceding six months. They supplied an enormous number of houses at rates actually unremunerative—in fact, they went down as low as 2s. per annum. But, as he said on a former occasion, this was "all in the day's march." Corporations and municipalities protected themselves against this compulsory philanthropy by having a minimum rate below which they could not charge. In Blackburn, for instance, the minimum was 13s. These bodies also had another means of meeting the point; for they could impose a water-rate all round before making individual charges. In their Company they had nothing of this sort. He was in hopes that in some of their districts they would soon see a better class of houses being built. With respect to expenditure, the year 1895 was a memorable and a remarkably unhappy one for them—causing them heavy and unavoidable outlay. So remarkable indeed was it, that it was not probable they would live to see its like again. The great frost of 1895 would be historical, more especially as regarded water companies, municipalities, and corporations throughout the United Kingdom. Then, after the frost, came the unprecedented drought in the Lea Valley during the first six months of this unfortunate year, when the rainfall was the least that was ever recorded. From letters to the papers, it would seem that there were still persons under the impression that frost and drought, by diminishing the quantity of water delivered, favourably affected the Company's revenue, by diminishing the pumping expenses. Nothing could be farther from the truth than this. He mentioned at their last meeting that, during the severe weather, they had to pump nearly double the usual quantity of water; and it now appeared that, from first to last, they might put down the cost owing to the frost last year at £24,000. With regard to the drought, there was an increase in outlay of £11,910, which, when analyzed, showed that the failure of the usual rainfall was mainly responsible for this unwelcome enhancement. They pumped over 500 million gallons more water than in the corresponding six months of 1894, which was rather a dry summer. This ran away with a large sum of money. Then, the purchase of extra water from the New River Company (who readily came to their aid), and the pumping of Thames tidal water from Bow Creek to supply the lower portions of the River Lea Navigation—thus enabling the Company to take a corresponding quantity of fresh water from the upper reaches—were novel and heavy charges. Rates and taxes, as usual, exhibited increased demands upon them. This half year, the additional impost amounted to £2400. There was also a larger bill to pay for law charges, which (through no fault or failure on the Company's part) had, since the formation of the London County Council, been a severe annual drain upon their exchequer. The law charges last half year showed an increase of £774, and brought up the whole amount expended during the past year to £4400. He might say that practically the expenditure of this large sum had been

forced upon them to protect themselves from attacks and aggression, The Company were never the assailants. They only endeavoured to maintain their just and legal rights; and this they had hitherto done with complete success. He could not help thinking that the pecuniary persecution to which the Water Companies had been subjected by the London County Council was unprecedented in parliamentary or municipal history. One well-known journal, when touching upon the policy of the London County Council during the preceding five years, said: "At a meeting of the Southwark and Vauxhall Company, the Chairman computed that, including the expenses devolving upon the whole of the eight Companies, and those incurred by the Council, a total of about a quarter of a million sterling had gone utterly to the bad. For all this outlay there was nothing to show." This seemed perhaps an outside estimate; but there was no doubt that the outlay had been enormous. The terribly hard part of all was that the ratepayers and the shareholders, out of whose pockets these large sums were abstracted, were virtually speechless and powerless. As an example of what their expenses were under this head, he might briefly mention the five attacks which had been made upon them during the past year. First, came the Council's Transfer Bills, which contained, among other remarkable provisions, a clause to the effect that the Arbitrators should exclude from consideration all points favourable to the Companies, but consider everything likely to depreciate the value of the undertakings. The Parliamentary Committee naturally would not have anything to say to this; and, during the discussion, Parliament dissolved. This cost the Company about £2300. Next, there was the Hackney inquiry into the interruption of their constant supply. This inquiry ended completely in their favour; but it cost them over £1000. Thirdly, there was the attempt to compel the Company to give a three-gallon, instead of the statutory two-gallon, flush through waste preventers. Inquiry was held by Local Government Board Inspectors, who decided against the proposed innovation. But the Company had, of course, to pay their share of the defence. The fourth attack was the introduction of a Bill of an unfair and unreasonable character, to compel them to maintain extraordinary and needless pressure throughout their entire district, merely to furnish a constant supply in a few isolated cases at exceptionally high levels. The objections to this measure had been sent to the proprietors; and the Bill was now before Parliament. In the fifth case, they were served with a writ to recover penalties under the Metropolis Water Act of 1871 for the interruption of their constant supply during the recent severe drought. The County Council proceeded with this case, notwithstanding the report of Colonel Ducat and Dr. Barry; and they had only just, at the eleventh hour, withdrawn it. The Council would have to pay the Company's taxed costs; but still there would be additional costs, which would have to be borne by the Company. He was happy to tell the meeting that the progress of their works was very satisfactory. Their new covered reservoir at Buckhurst Hill, where the old water tower stood, had been completed; and a large number of householders outside London were now being supplied therefrom. Another large covered reservoir at Hagger Lane, near Woodford, containing 8 million gallons would soon be similarly available for supplying portions of the Company's Essex district. Improvements and measures for augmenting their supply and their pumping power, to meet the annually increasing demands upon them, were being actively carried out. The two large reservoirs at Walthamstow—called "the East and West Warwicks"—had made remarkably good progress during the past six months, under the able management of the Contractors, Messrs. John Aird and Sons, as could be seen by those travelling from time to time by the Great Eastern Railway. But perhaps the most interesting and satisfactory achievement had been the completion of the extension of the Racecourse reservoir by the Contractors, Messrs. Kirk and Randall, the capacity of which had (thanks to Mr. Bryan's professional and practical knowledge) been raised from 75 million gallons to about 300 million gallons. They had, therefore, this largely increased volume of storage ready to meet any unforeseen circumstances. He was glad to state that their water thoroughly maintained its usual high character for purity. Occasionally one heard remarks uncomplimentary to the Company's main source of supply, the River Lea; but the Government Analyst, in his last report to the Local Government Board, set any doubt at rest by recording that "the East London Company's water derived from the Lea was, on the average, much superior to any of the Thames waters." Another favourable feature as regarded this question was that Messrs. Crookes and Dewar, in their last report, stated that the Company's unfiltered water contained less bacteria per cubic centimetre than that of any other Company. They also declared that "during the past month [February] the water supplied to the Metropolis was of first rate quality." He (the speaker) had lately attended a lecture given by Professor Frankland, the Government Analyst, upon the London Water Supply; and three of the Professor's conclusions would be of interest to them. First, that storage, such as the Company had at Walthamstow, most favourably affected the quality of the water "both chemically and bacterially," and that "the effect of sand filtration, as carried out by the various Water Companies, was simply astonishing." Secondly, that "not a single harmful organism had ever been discovered, even in the unfiltered river water as it entered the intakes of the various Companies, although these organisms had been diligently sought for." Thirdly, that "for half a century at least we had at our doors an ample supply of water which, for palatability, wholesomeness, and general excellence, could not be surpassed by any supply in the world." Regarding the Hackney inquiry, which was held by Colonel Ducat and Dr. Barry, by order of the Local Government Board, into the alleged deficiency of supply during the drought, he (the Chairman) said at their last meeting that they rather courted the investigation, as whenever they came before a competent tribunal, they invariably benefited thereby. Although this might then have seemed rather rash and over-confident, as matters had turned out, the Directors were right in their anticipations. The decisions of the Inspectors were in the Company's favour on all points. He would briefly mention the main contentions against them, and the judgments thereon: First, that the Company did not, during scarcity, use proper measures to maintain constant supply. Secondly, that the Company had been to blame for not constructing additional means of storage. Thirdly, that the inability to maintain a constant supply was caused by leakages from "shattered mains" not repaired after the frost. As for the first allegation, the Inspectors considered the evidence adduced by the Company proved that there had been an unprecedented drought in the Lea Valley, thereby decreasing the flow of the river, and increasing the demand for storage; that there had been excessive waste by consumers (it being shown in evidence that in hundreds of cases garden hose-pipes were left running for 24 hours at a time); and that the Company had done all in their power to obtain additional supplies. With reference to the point of not providing additional storage, one evening paper, when touching upon this subject, remarked that it showed considerable "hardihood" on the part of the Company's opponents to urge this particular contention, as it was entirely through the latter that the Company were unable to obtain the necessary money and powers from Parliament in 1893 to carry out their contemplated extensions. The Inspectors, after stating that the Company had taken all necessary precautions, recorded that "events have justified the demands of the Company for more storage and for more pumping power; and after the speech made in the House of Commons by Mr. Mellor, the Chairman of Ways and Means, in which he said that the House would 'incur considerable responsibility' if it refused to send the Bill to a Committee, the responsibility for the want of this storage in 1895 cannot justly be saddled upon the Water Company." With regard to the contention that "shattered mains" were the cause of the diminution in the water supply, this was a clever and ingenious theory, as, could it have been established by their opponents, it would have shifted from the latter the responsibility of having wrecked the Company's Bill as already explained. The opinion of the Inspectors, however, was to the effect that all the mains were repaired in April before the drought; that the reservoirs were full in May; and that, when the constant supply was resumed in September, the daily delivery did not exceed the normal quantity. Their recorded judgment was therefore to this effect: "The theory that the loss of water during the drought was due to the 'shattered mains' was not in our opinion proved at the inquiry, nor supported by other witnesses." In a word, the Board might say that the result of the Inspectors' inquiry was that it was the theory that was "shattered," and not the mains. There was one rather grim piece of humour during the progress of the inquiry. There had been a meeting of a District Board of Works, at which one of the members asked the Medical Officer of Health whether he had "any well-authenticated cases of disease due to the scarce supply of water," to which the doctor replied, "I am afraid I have not." When this came out in evidence, Mr. Pember (the Company's Counsel) remarked: "I am surprised you should have said 'I am afraid I have not.' In my supernal charity, I should have said: 'I am glad I have not.'" As regarded the parliamentary situation, the proprietors would remember that the eight separate Transfer Bills promoted by the London County Council were at the dissolution in July suspended at the stages they had then reached. Six of them awaited second reading; and two had been partially gone into by the Committee, but would have to be re-opened *ab initio*. In the autumn, the London County Council virtually decided that they would not proceed with the Bills, but would invite the Government to bring in a measure dealing with the water question. Subsequently, however, they decided to push the Bills on in the present session. Meanwhile, Lord James of Hereford introduced into the House of Lords the Government measure for dealing with the Metropolitan Water Supply; and the Bill was read a first time. Having mentioned the provisions of the measure, the Chairman observed that it was clear that the Government Bill and the Transfer Bills could not both be proceeded with at once—they were inconsistent and incompatible. The London County Council, however, determined to press on their measures; but they were defeated by a majority of 162, thereby rejecting the second reading of the six Bills, and putting an end to the remaining two. There still remained, however, the "Height of Supply Bill," which the County Council were bringing in against their own Company. This not only upset the well-considered and duly authorized arrangements of 1852, which were again confirmed by the Metropolis Water Act of 1871, but would cause endless and needless outlay both to the consumers and the Company, without any result. The Parliamentary and Water Committees of the London County Council advised that body not to proceed with the Bill. But this advice was rejected; and, as at present arranged, the second reading would take place on the 14th inst. The "Reasons Against" had already been sent to the shareholders, who, he hoped, would do their best to induce members to vote against this very unfair and hostile measure. As regarded the staff, from what he had already mentioned respecting the progress of their works, they would have gathered that the Engineer (Mr. Bryan) continued to maintain the high esteem in which he was universally held. The works which this gentleman had constructed for the benefit of the community and the Company would for years remain lasting memorials of his talent, skill, and foresight. The Secretary had successfully grappled with all the difficulties of the past six months; and as regarded the parliamentary business, where the situation often changed from day to day, Mr. Crookenden's head and pen were ever on the alert. Upon some very important questions which had lately come before the Board, he (the Chairman) might also say that the Secretary's advice had proved both sound and correct. Some of them possibly would think that the dividend recommended might have been larger; but when he informed them that the unlucky year 1895, by its frost, its drought, and its law charges, carried off from revenue £35,000 in hard cash, they would doubtless agree with him that it said much for their vitality, their works, and their staff that they had been able to pay 7 per cent. for the past very exceptional twelve months, and carry forward £8500. Their new works were already aiding them very materially; their outside district was increasing in population; and their whole system was sound and perfectly healthy. So that, as far as one could foresee, all looked well with them. They might have heard something about negotiations going on with the Chairman of the London County Council. Sir Arthur Arnold had been to see him (the speaker) twice, and they had had pleasant, friendly chats. Not only, however, was no business done, but none was begun. On the second occasion, when it

was clear that Sir Arthur's "occupation" was gone by the Government Bill, he gathered that the views of himself and of the Chairman of the London County Council as to what would be fair proposals were certainly divergent. Mr. Banbury concluded by moving the adoption of the report, and the payment of a dividend of 3½ per cent. (less income-tax) on the ordinary stock for the half year ended Christmas, 1895, payable on the 9th inst.

Mr. HERBERT DALTON seconded the motion, which was at once carried unanimously, without discussion.

Resolutions were afterwards passed re-electing the retiring Directors —Messrs. Herbert Dalton, William Smiles, M.D., and Herbert Helme— and the retiring Auditor, Mr. George Ilsley.

On the motion of Mr. ILSLEY, seconded by Mr. T. BADDELEY, a cordial vote of thanks was passed to the Chairman and Directors, the Engineer, the Secretary, and the staff generally.

The CHAIRMAN briefly acknowledged the vote, and the proceedings terminated.

BRISTOL WATER-WORKS COMPANY.

The Annual Meeting of this Company was held a few days since, when the report which was noticed last week was submitted for adoption by the Chairman (Mr. Edward Bush). Dealing with the accounts, he said the receipts from water-rents had increased by £3593, and the advance in the meter-rents was about £1100, which showed their business was a very increasing one, and also demonstrated that the Directors were prudent in obtaining further supplies from the Yeo, This was the Jubilee Year of the Company's existence; and to have such an income as £105,000 was very encouraging for the future. When he first became a Director, 38 or 39 years ago, the income was not £15,000; and he had seen it increase to more than seven times as much. As to the frost, that had made the last year a very memorable one. The Directors, when they found there were so many of their customers' service-pipes frozen, determined to minimize the distress among them as soon as they could by employing 130 special men and 17 water-carts to deliver the water from stand-pipes; and he thought the public gave them credit for doing their very best. The Company had, however, to pay £1909 for it. The cost of repairs to pipes was £650; and the remaining £1259 was spent upon men and water-carts. There was a good deal of extra pumping at Chelvey on account of the frost and drought; and a good deal of leakage owing to the drought of two or three months following the frost. The Yeo Valley reservoir was progressing as well as could be wished; and during the winter not a single day was lost through frost. He had been asked outside what had been done in regard to the Committee instructed by the Town Council to negotiate for the purchase of the Company's rights; and his only reply was that, as a Company, they had, so far, heard nothing about it, and, individually, he was not anxious to. They had connected 1446 new houses, which was 54 more than the previous year; and they were going on this year in a very prosperous way up to the present time. The report was adopted; and dividends at the rate of £7 and £4 18s. per cent. per annum were declared. After paying these, a balance of £5638 will remain.

A CONTINENTAL MUNICIPALITY AND GAS AND WATER.

Not without interest just now is the information contained in Consul Robinson's report on Amsterdam, forwarded to Lord Salisbury, as it gives an insight into the manner in which gas and water companies are treated by the Amsterdam Municipality. The Consul says the past year has been an exceptionally interesting one as regards the negotiations of the Municipality for the acquisition of the properties of the Companies supplying the city with gas and water, and the Telephone Company's wires, &c. The city has been at law with the Gas and Water Companies for some years past; disputes having arisen as to the interpretation of the terms of the concessions granted to them. In the case of the Water Company, a very stringent interpretation of the terms of an exceedingly onerous concession has practically forced the unfortunate shareholders to sell their property to the Municipality at a sacrifice of more than two-thirds of the share capital. The Telephone Company, to which very unsatisfactory terms were at first offered, on the expiration of the concession, for the purchase of their installation, succeeded eventually in obtaining a more acceptable arrangement for the transfer of their business to the Municipality. Notice of withdrawal of their concession in 1897 has been given to the Gas Company by the Town Council; and this undertaking will also probably pass into the hands of the Municipality. The purchase of the Tramway Company's lines is also reported to be in contemplation. A considerable majority of the Town Council appears to favour the acquisition of all similar undertakings; and at one time the tone of their discussions was bitterly adverse to all concessionaires. Of late a more just spirit appears to have prevailed; but the experiment of municipalizing all such public undertakings seems likely to be carried out pretty thoroughly. The objects sought to be obtained are twofold, and are in some degree inconsistent with each other—one section of councillors and of the public looking forward to supplying the citizens with cheaper gas, water, and tram fares, and cheaper telephonic communication; while another expects to improve the financial position of the city by profits to be derived from the undertakings themselves. To attain both objects will probably be impossible; but the result of these experiments will be looked forward to with the greatest interest. The course of negotiations may, however, serve as a warning to investors in companies based on municipal concessions. The risks which they run are now generally out of all proportion to the profits to be realized.

Cape Town and District Gas Company.—The Directors of this Company recommend the payment of a dividend for the six months ending Dec. 31 last at the rate of 8 per cent. per annum.

THE LEEDS GAS COMMITTEE AND THEIR WORKMEN.

The Men Canvassed.

In the course of the discussion in the Leeds City Council on the report of the Gas Committee dealing with certain demands made on behalf of the gas workers for alterations in wages and hours of labour, as reported in our issue for the 24th ult., Mr. Ambler stated that "if the labourers in the yard were canvassed, 90 per cent. of them, he undertook to say, would express satisfaction with their present conditions." In order to test the truth of this statement, the officials of the Leeds branch of the Gas Workers' Union issued ballot-papers to the stokers, enginemen, firemen, purifying-men, cinder-throwers, and yardmen employed at the different stations, asking the single question: "Are you satisfied with your present conditions of work?" The result was made public last Tuesday. Of the 600 papers sent out, 541 were returned properly filled up. Only 67 replied in the affirmative; and 474 in the negative. The officials of the Union are of opinion that practically the whole of the 67 papers were returned by engine and purifying men, whose hours the Gas Committee have decided to reduce from twelve to eight a day. A meeting of the men was called for last Sunday, to consider what steps should be taken under the circumstances. It is stated that the officials intended to submit certain proposals, which, if accepted, would obviate "the necessity for a strike."

THE BOLTON CORPORATION AND THE SALE OF GAS RESIDUALS.

An Alleged "Ring" of Tar Buyers.

At the Meeting of the Bolton Town Council last Wednesday, there was a lengthy discussion in regard to the acceptance of a tender from a Welsh firm for the coal tar at the gas-works. Mr. Tootill first called attention to the matter, and said there had been a "ring" formed by the leading tar buyers. From information he had in his possession, the buyers might take it that a proposal would be made at no distant date by the Gas Committee for the adoption of a system and plant for dealing with their own tar, instead of putting it upon the market. Messrs. Turner, whose tender had been accepted for the tar, had offered 7s. 4d. above the market price; and he said the members of the Gas Committee would have been foolish not to have accepted it. Before long they would have offers at 12s. 6d. per ton above the market value; and he should advise their acceptance. But the "ring" would make a mistake if they thought the Corporation would be "had" after the small firms had been run out, because Bolton would follow the example of Manchester, and put down residuals plant of their own. Alderman Scowcroft moved that the minute accepting the tender of Messrs. Turner be referred back. He said that when he ascertained that the firm were offering 28s. 9d. for a commodity the market value of which was 21s. 6d., he asked himself if there was not something behind. He found that there was a "ring" of buyers. He asked the Council to consider what would be the result if the "ring" was successful. For a time an unreasonable price would be offered for the tar, and when the small firms had been crushed out, in about two years the Corporation would be completely in the grasp of the "ring." Their policy was not to support the "ring" in any way; and it would be to the ultimate advantage of the Corporation to reject the tenders of those who formed it. Mr. Wild took a different view of the matter. He believed that there had been a "ring" keeping the price down for some time; and there having been a quarrel among them, the Corporation were now getting the market price for their product. Mr. Edge pointed out that the Corporation had about £7000 worth of tar to sell, and that the tenders of the two local distillers were far below the others. In fact, the local people only offered 21s. 6d., as against 28s. 9d. by Messrs. Turner and Co. The buyer for the latter was asked by the Gas Committee if they were members of the "ring;" and he said they were not. But, in reply to a further question, he said they sold their tar to anyone who cared to buy. Mr. Smith remarked that the difference between the price obtained last year and that offered by Messrs. Turner meant to the Gas Department a sum of £3000 a year. It was not likely, as business men, that they would sacrifice so large a sum. He also pointed out that there were other tenders submitted with prices fixed at 24s., 25s., and 26s. 6d. Mr. Ramsden suggested that the Gas Committee should make as much as they could out of the "ring," and use the money to put down plant for dealing with their own products. After some further discussion, the amendment referring the matter back was adopted by 21 votes to 19.

PENRITH GAS SUPPLY.

A Highly Satisfactory Year's Work.

At the last Meeting of the Penrith District Council, the Gas Manager (Mr. E. Shaul) presented his report for the year ending Dec. 31 last. It showed that the quantity of gas made was 37,736,300 cubic feet, as against 34,715,100 cubic feet in 1894—a rise of 3,021,200 cubic feet; and, as compared with the previous year, there was an increase of 200 cubic feet in the yield of gas (10,282, as against 10,078 cubic feet), and a little over ½ cwt. of coke sold, per ton of coal carbonized. There was also an increase of 2,790,000 cubic feet in the consumption—the largest Mr. Shaul had ever had the pleasure to report. It was equal to very nearly 10 per cent. on the make, and was divided between the two systems of supply—viz., ordinary, 2,519,200 cubic feet; prepayment, 271,300 cubic feet. After allowing for the larger quantity of coal carbonized, a saving of 100 tons, equal to £66, was effected in the coke used in the furnaces. This was due to the two beds of retorts heated on the regenerative system, which have been working very satisfactorily since they were first lighted in December, 1894. The conversion of part of the old bench of retorts from the direct-firing to

the regenerative system was completed in December last; but they have not been lighted. The prepayment system still maintains its popularity. The quantity of gas supplied under it last year was 832,300 cubic feet; the cash received amounting to £140 4s. 9d. The number of new customers was 43; making a total of 168. There were 42 cookers and 33 heating-stoves supplied last year; bringing up the totals to 232 and 269 respectively. Of sulphate of ammonia, 25 tons were sold, at an average of £9 11s. per ton—yielding a profit of £71 3s.; and the local demand is increasing. The spiral-guided holder at the works sustained some damage during the intensely cold weather of February last year. But this was promptly repaired by putting in new inlet and outlet pipes, and fixing wrought-iron carriages to each lift, in place of the cast-iron ones, some of which were broken. Steam injectors are now fixed to the tank and holder, which it is expected will prevent the formation of ice, and so avoid a repetition of the damage. Mr. Sweeten, in moving the adoption of the Gas Committee's minutes, including the report, said they had had in the past year a "record" make of gas in the bulk, and also per ton of coal carbonized. The increase of 2,790,000 cubic feet in the consumption was the largest they had ever had. By the adoption of regenerator furnaces, they had been able to save a large quantity of fuel—about 100 tons of coke, representing £66. Had it not been for this system, the Gas Committee would not have been enabled to supply the maximum quantity of gas which had been used—sometimes amounting to considerably over a million cubic feet per week. The increase in the number of cookers was very satisfactory; and they had now 168 "penny-in-the-slot" meters, with an average consumption of 4000 to 5000 cubic feet of gas per annum. There were 500 gas cookers and fires in use. He calculated that their consumption would be about 5 million cubic feet; and they were gradually on the increase. Had it not been for these, the consumption would have been pretty nearly stationary. The sulphate plant had yielded a profit of £79, notwithstanding that this article had fallen very much in value. He thought, however, it would be agreed that a profit of £79 on a turnover of £237 was not bad. When the works were taken over by the Council, the loss of gas was equal to 20 per cent. In other words, one-fifth of the gas made was never paid for, because it escaped. The reduction of this loss had been due to the fact that old mains had been taken up, and new ones put in their place. A thorough examination of the services had also been made; and whenever leakage was discovered, it was promptly attended to. The quantity of gas unaccounted for last year was 1¼ million cubic feet, or only 4·09 per cent. He could not give the financial results for the past year, because they would not be prepared until some time after the 25th of March; but notwithstanding that the reduction in price to 2s. 6d. meant the giving back to the consumers of something like £600, he was quite hopeful the works would pay for themselves, and leave a slight margin of profit. The Chairman (Mr. J. Scott) said he remembered that when the Gas Company handed over the works to the town, the leakage was from 20 to 25 per cent. He thought it was wonderful that this had been reduced to such a low figure as it was now. The minutes were adopted.

THE FATAL EXPLOSION AT THE CHELTENHAM GAS-WORKS.

The inquest on the body of John Bird (aged 52 years), who lost his life on the 19th ult., through an explosion in a boiler at the Cheltenham Gas-Works—as recorded in the following issue of the "JOURNAL"—was opened, by the Divisional Coroner (Mr. J. Waghorne), on the 20th and continued on the 27th ult. The Gas Company were represented by Mr. W. H. Griffiths (Solicitor), Mr. R. O. Paterson (Engineer and Manager), and Mr. J. A. Coombes (Assistant Manager); and Mr. Arnold, the Inspector for the district under the Factories and Workshops Acts, was present on behalf of his department. At the first sitting, merely evidence of identification was given. On the inquiry being resumed, Mr. Coombes was the first witness called. He stated that the accident occurred in a boiler which was one of a pair recently erected in their present position; and the deceased, with two other men—Robbins and Derrett—was engaged cleaning it. The men commenced work on March 11, and had continued up to the day of the accident. The boiler was 14 feet long by 5 feet in diameter; and its capacity was 206 cubic feet. The manhole was about two-fifths of the distance from one end, and was 17 inches in diameter. Light was afforded the men by means of a gas supply at the side of the boiler setting, from which a flexible tube led into the boiler. The length was sufficient for the burner in which the tube terminated to be moved to any position in the boiler. The tube outside the boiler was india-rubber; and inside the boiler, a patent flexible metallic tubing. In addition to the cocks attached to the flexible tube, there was a tap on the burner. He had no reason to suppose that the condition of the tubing was faulty; and no complaint had been made to him. No damage appeared to have been done to the boiler by the explosion. On the morning of the 19th ult., witness was called shortly after half-past six to the scene of the accident; and he found deceased jammed up between the slates and rafters of the roof. Two of the slating laths had been lifted, and the slates removed by the impact of his body as he was blown from the boiler below. He was quite dead. On examination, witness found the tap on the wall open, and also that on the burner, which was still in the boiler. Both the burner and its attachment to the flexible tube were quite sound. At a pressure of 10-10ths, the burner passed 8 feet of gas per hour; and 16 feet—*i.e.*, two hours' leakage—would cause an explosive mixture in the boiler. The two men who were assisting deceased (both of whom were injured) were also called. It appeared from their evidence that each man had a burner, which was left in the boiler all night, and that it was the duty of the last man out to extinguish the light. On the night previous to the accident, the deceased was the last to leave; and no one could say whether he turned off the gas or not, but the assumption was that he did not. Next morning the manhole was found covered with a tin plate and sack. These deceased removed, and went into the boiler to get a match, when a terrific explosion occurred, knocking down the two witnesses outside, and blowing deceased through the manhole into the roof. Dr. Cardew, who was summoned at the time of the accident, also gave evidence; and, in reply to a question, he said the gas might have stupified deceased so much, that he did not know what risk he was running by striking a match. The jury returned a verdict that death was due to injuries accidentally sustained by reason of an explosion of coal gas which had escaped into the boiler, in consequence of the taps supplying the gas for lighting the interior having been inadvertently left open. A Juryman expressed a wish that a recommendation should be added bringing to the Company's notice the desirability, in future, of ensuring that, under similar circumstances, the burners should be withdrawn from the boiler on the men leaving work. The Coroner remarked that he was quite sure the Company fully realized their responsibility in the matter; and Mr. Griffiths endorsed his words.

ELECTRIC LIGHTING NOTES.

The Cheltenham Corporation were granted an Electric Lighting Order in 1890; and it was put into operation in 1893-4. The Local Government Board then sanctioned a loan of £16,000; and the works were opened on May 16 last year. The Corporation have now made application for a further £25,000 under circumstances explained by the Town Clerk (Mr. E. T. Brydges) to Major-General Crozier at an inquiry held by him on the 27th ult. Mr. Brydges stated that the original estimate was exceeded by about £880. As sanctioned by the Local Government Board, the scheme embraced an item of £1150 for street lighting; but the demand for private consumption followed so quickly upon the establishment of the station, that it was thought better to postpone for a time the question of public lighting, and apply the sum mentioned to the extension of mains for the private supply. As time went on, the demand for the light became such that the Council considered it necessary that additional plant should be provided; and an application was made to the Board last August for £10,000. In the months which had elapsed a considerable portion of the £10,000 had necessarily to be spent. Pending the sanction to the loan, it had appeared to the Council that extra capital to the extent of £15,000 would be required to develop the undertaking during the ensuing year; and the Board decided to hold the inquiry into both applications at the same time. In the interval between the two applications, certain events had occurred which might, said the Town Clerk, properly be alluded to as strengthening the position of the Corporation in regard to the electrical undertaking. The Gas Company were promoting a Bill in Parliament to raise further capital; and acting on a principle now well established, the Corporation were anxious to take advantage of the opportunity to acquire the gas-works at a fair price. With that object, they drafted a Bill; but on a poll being taken of the owners and ratepayers, the proposal to municipalize the gas supply was rejected by a large majority. One of the chief reasons—he could not call it a strong one—urged by the opponents to the purchase was that the Corporation already possessed the electric light; and the competition between the Corporation and the Gas Company would be good for all concerned. That argument at any rate was largely made use of; and no doubt it influenced many votes. Without admitting the soundness of that view, the result of the poll must be taken to be a distinct mandate from the ratepayers to the Corporation to proceed with the development of the electric light. The Corporation were now approaching the end of the first year of the working of their station. It was estimated that there would be a loss on the year, because such undertakings seldom paid in the first year or two. The Gas Company commenced with the modest capital of £25,000; and this had increased until at the time of their present application to Parliament, they had a share capital of £200,000, paying dividends at 10, 7½, and 7 per cent. No doubt similar progress awaited electricity. Alderman Norman gave some information as to the development of the business. The undertaking, he said, began with under 900 8-candle power lamps. At present 6100 lamps were wired and connected, and they had applications for an additional 700 lamps. He anticipated that, at the end of the second year's working, the receipts would not only meet the working expenses, but also the whole of the instalment and interest of the capital, including the £25,000 now asked for. The Surveyor and Electrical Engineer explained the items in the estimates. In concluding the inquiry, the Inspector remarked that it was not to be expected that a well-built and beautiful town like Cheltenham should be without electricity. Reference had been made to a proposal to buy the gas; and probably if the town had bought its gas-works twenty years ago, it would have been enabled with the profits to pay for the electric light.

Last Wednesday, the St. Pancras Vestry received a long report from their Chief Electrical Engineer (Mr. S. W. Baynes) "respecting overhauling, re-arranging, and increasing certain portions of the distributing mains and feeders." The works detailed therein are estimated to cost £3415; and the Vestry sanctioned them; £1925 of the amount for increasing mains to be placed to capital account, and £1490 for overhauling them and altering motors to be charged as expenditure on revenue account. It is curious to note that while this decision was arrived at practically without discussion, the disputed item of £14 claimed by Professor Robinson as commission again caused a long and angry debate. The Committee reported that they regretted the circumstance—*i.e.*, Professor Robinson's acknowledged error in marking "final" to the certificate of Messrs. Reid Brothers' bill of £697—but recommended that the £14 and the contractors' second bill of £358 should be settled. Mr. Barnes pointed out that two commissions ought not to be paid on the same job; but Mr. Sweet defended his Committee, and recapitulated the arguments already reported. The quibble about such a small item in settlement was, he thought, ridiculous. Not so Dr. Bell, who waxed indignant at a gentleman calling himself "Professor" marking a certificate "final" when the work was not finished. In the end, the Vestry decided to pay both items, and settle the matter; but they were not so generous when a letter from Messrs. W. T. Henley's Telegraph Works Company, Limited, dated the 19th ult., was considered. In this communication, the firm pointed out an error in a completed

tender—viz., 1s. 8½d. had been inadvertently quoted and charged for 0·20 cable, instead of 2s. 8½d.—a little inaccuracy involving an additional charge of £580 on the contract, for which the writers hoped the Vestry would allow them to send in an account. The Committee, however, recommended that no action be taken; but Mr. Rutter moved that the matter be referred back for further consideration, inasmuch as the incorrect price had been charged for cable used on extra work as well. Mr. May, in seconding this, pointed out that, even allowing for the additional £580, the tender was still the lowest. Mr. Doll emphasized the danger of altering contracts under the seal of the Vestry; and Mr. Menzies defended the firm, whose mistake was found out by the County Council. In the end, the amendment was defeated; and the Vestry will not (at present, at any rate) pay for their contractors' error. The spare plant for the King's Road station has been tendered for by seven firms; Messrs. Crompton's, for £6456, being accepted. The lighting-rate has been fixed at 1d. in the pound, bringing in £6347, of which £3200 is for gas, and £1280 for electricity.

During a discussion, on Monday last week, at the North Walsham District Council, Mr. Dyball moved the advisability of adopting the electric light in place of gas; saying that a saving of 25 per cent. would be effected by such a change. It was resolved to refer the subject to a Committee for consideration. But several members opposed; it being pointed out by one of the opposition that at Cowpen, in Northumberland, electricity had been adopted, and, after six years' trial, had been given up in favour of gas, principally on account of the expense, but also because, with all their outlay, the authorities were only able to light the chief streets—all the bye-streets being kept in darkness. The poles at Cowpen have only lately been removed; and we learn from a correspondent that a local paper derisively declared that "not even a solitary councillor applied for permission to secure part of a pole out of which to hew a decent walking stick in memory of Cowpen's unlightened days."

In addition to the sum of £45,385 already borrowed by the Cardiff Corporation for the purposes of electric lighting, they have sought the sanction of the Local Government Board to the raising of £12,500. It was explained to Mr. G. W. Wilcocks, who has inquired into the application on behalf of the Board, that the money is required for extensions both at the central station and in the distribution system. Since the introduction of the light in December, 1894, there has been an increased demand for current. At present 10,000 8-candle power lamps are being supplied; and applications have been received for 2500 more, which, owing to want of power, cannot be served. The proposed outlay will provide for an additional 10,000 lamps.

THE LONDON COUNTY COUNCIL AND THE WATER QUESTION.

At the Meeting of the London County Council last Tuesday—Sir A. Arnold in the chair—the subject of the position of the Council in regard to the Metropolitan Water Question, in view of the recent rejection by the House of Commons of their Transfer Bills, was under consideration.

Mr. W. H. Dickinson (the Chairman of the Water Committee) asked the Chairman of the Council what course he proposed to take with regard to his position as negotiator for the purchase of the undertakings of the Water Companies in consequence of the rejection of the Council's Bills.

The Chairman: The negotiations have not gone farther than was indicated in my reply to Mr. Idris on the 10th of March. I may, however, add that there were two points upon which I took firm ground—first, that we should consider procedure by arbitration under the Lands Clauses Act as overpassed by the work of the Plunket Committee; and, secondly, that we should avoid the Birmingham precedent of payment by perpetual annuities without power of redemption. I maintained that, in any agreement, the ratepayers are entitled to the advantage of their superior credit; that, therefore, if the payment were not by a lump sum, the annuities representing dividends should be reduced or redeemable at fixed periods at an agreed price; and that, failing agreement, the arbitration should be full, free, fair, and decisive, giving to all parties the due consideration of their respective claims. Under present circumstances, I shall not proceed with the negotiations. I desire to repeat my acknowledgments for the courtesy with which I have been received, and to record my conviction that, if the Council's Transfer Bills had proceeded, a settlement by agreement was not impossible.

The Earl of Onslow asked the Chairman if he had received from any of the Companies a reply in response to the proposition which he understood he had made.

The Chairman said that his proceedings were by conversation.

It was decided to enter the Chairman's statement on the minutes.

A report was then presented from the Joint Parliamentary and Water Committee dealing with the rejection of the Transfer Bills. In the course thereof, they stated that the Chelsea, East London, Grand Junction, Kent, New River, and West Middlesex Bills were thrown out on second reading in the House of Commons; and that the order for the committal of the remaining two Bills—the Lambeth and the Southwark and Vauxhall—had been discharged. On the 5th of March, the Committee reported to the Council that they had most carefully considered what action should be taken, and had come to the conclusion that they must give a certain discretion to the members in charge of the Bills, seeing that circumstances might arise which could not then be forecast; but that it appeared to them desirable, from every point of view, that the Council should give the necessary authority to move the second reading. This was agreed to; an amendment brought forward by Sir J. Lubbock, proposing further adjournment, and omitting to take a division on second reading, being defeated. Acting under this authority, which left the Committee a discretionary power, and it having been intimated to them by the Government that a further adjournment would be convenient to them, they consented to the second reading being postponed from the 13th to the 24th of March. Communications took place between the President of the Local Government Board (Mr. Chaplin) and Mr. Stuart, the member in charge of the Bills, who was anxious to learn whether, under any, and if so what, circumstances the Government would be prepared to assist in passing the second reading of the Bills. The result was that he was informed by Mr. Chaplin that the acceptance of the principle that compensation should be paid to the Water Companies under the provisions of the Lands Clauses Consolidation Act must be a condition precedent to further negotiation. This position was stated by Mr. Stuart in the course of the debate in the House of Commons; and the accuracy of the statement as to the proposed condition was confirmed by Mr. Chaplin, who said that "to secure the speedy passage of the Government measure, it was, of course, in the first place, necessary to disarm all opposition. He soon discovered that to do this it was necessary for the County Council to abandon the arbitration clauses which are at present in the Bill, and to rely on the ordinary law." Mr. Chamberlain also insisted on the view of the Government that there must be no special arbitration clause, but that the "ordinary arbitration clause"—*i.e.*, arbitration under the Lands Clauses Consolidation Act—should be put in. The Committee observed that, in the event of both the Government Bill and the Council's Bills passing into law, this last condition must of necessity have taken effect; nor had this ever in any way been contested by Mr. Stuart. He, however, felt himself unable to accept the condition precedent proposed by the Government. Arbitration under the Lands Clauses Act was expressly declined by the Council in their resolution of the 17th of December last, which contained these words: "The purchase price of the existing undertakings shall not be assessed under the provisions of the Lands Clauses Consolidation Act, but shall be based upon the fair and reasonable value of those undertakings; due regard being had to the rights, special circumstances, and obligations of the Companies." The Committee remarked that the settled policy of the Council had been to place before a Committee of Parliament such a clause as would ensure the consideration by the Arbitrator of all the circumstances affecting the real and intrinsic value of each of the Companies' undertakings; the opinion having been expressed again and again by members on both sides of the Council that any other form of arbitration would prove disastrous to the interests of the ratepayers. The claim of the Companies before the Committee of the House of Commons which considered this question last year was that compensation should be awarded under the provisions of the Lands Clauses Consolidation Act. The Committee did not accept this contention, but, on the contrary, accepted the general principle, though not the original form of clause, contended for by the Council. A new clause was, therefore, presented to the Committee; but Mr. Pope, as Counsel for the New River and Southwark and Vauxhall Companies, contended that it did not carry out the intimations of the Committee. The Chairman (Mr Plunket), however, stated that, speaking generally, and subject to further consideration, and also to one or two points to which he wished to call attention, the Committee did not see anything in the clause which was inconsistent with the decision already arrived at. The enormous importance of the form of this clause to the ratepayers in the county of London, and also in the outside areas, was indicated in the remark made by Mr. Littler, the Counsel for the Kent and New River Companies, in his address to the Committee on June 27, 1895: "I know they"—*i.e.*, the Council—"have said, and you also know from the evidence which is before you, that on the form which clause 6 takes it may make a difference of from 12 to 15 millions, or even 20 millions, in the price which they may have to give." Mr. Littler also expressed the opinion that the new clause was an absolutely worse clause for him than the clause which had been struck out of the Bill. Without adopting this opinion, it was evident that there was, in Mr. Littler's view, a difference of from 12 to 20 millions in the financial result to the ratepayers dependent on the passing of the clause proposed by the Council instead of that proposed by the Companies—viz., arbitration under the Lands Clauses Consolidation Act. The Committee concluded their report as follows: "We regret that the insistance by the Government on the acceptance of terms of purchase which have always been regarded by the Council as certain to involve the ratepayers in an enormous expenditure beyond the value of the undertakings has caused the destruction of the Council's Bills, and the indefinite postponement of purchase."

On the motion for the reception of the report,

The Earl of Onslow moved, as an amendment, that the report be not received. He emphatically protested against being included in the "we" in the final paragraph of the report. He traversed directly the statement contained in the paragraph, because it was not the terms which were offered by the Government that had caused the destruction of the Council's Bills; and the rejection of the Bills did not mean the indefinite postponement of purchase. The reason the Bills were killed was that the Council decided not to accept an amendment, proposed by Sir John Lubbock, instructing members in charge of the Bills to move the second reading, and then agree to an adjournment. If it had been decided to give this instruction to Mr. Stuart, it would have been possible, proper, and right of him, when Mr. Chamberlain made him a proposal, to have given the Council and the Parliamentary Committee an opportunity of considering that proposal. He (Lord Onslow) ventured to say that, if this course had been adopted, in the words of the spokesman of the front Opposition bench—Mr. Sydney Buxton—"the second condition was such that he did not see why, if there was really a desire for concession on both sides, some agreement might not be come to." When the two parties had arrived so nearly at terms of agreement, if Mr. Stuart had then consented to postpone the Bills, his belief was that the Council would have seen a way by which their existence might have been allowed to continue. No opinion was taken in the Parliamentary Committee as to what should be sent up; and he protested against words being put into the mouths of those who were most distinctly and diametrically opposed to them.

Mr. H. P. Harris seconded the amendment.

Mr. Costelloe challenged Lord Onslow to deny that it was the refusal on the part of the Council to accept the arbitration clause in the Lands Clauses Act which caused the destruction of the Bills; and that, if the Council had been prepared to accept it, the Bills would have been read a second time.

Dr. Collins (the Vice-Chairman of the Council) said that what the

public wanted to know was why the Water Bills had met with their undeserved fate; and from this point of view the present discussion was eminently unsatisfactory.

Mr. BEACHCROFT appealed to the Chairman of the Committee to withdraw the objectionable portion of the report. Mutual recriminations at this stage would, he said, indefinitely delay any settlement of the water question. Personally, he believed that the only practicable settlement with the Companies would be by agreement, and not by compulsion; but everything would depend on the attitude of the Council during the next few months. He hoped that oil would be thrown on the troubled waters.

Mr. W. H. DICKINSON trusted the Council would allow the report to go forward as an accurate statement of everything that had happened. It was generally recognized by all lawyers who had had to deal with the administration of the Lands Clauses Act that, however just the phraseology of the Act might be, its execution had grown to be a public scandal in the administration of the law of England. This was the reason why the Council had always been opposed to any arbitration with the Companies under the Act.

Mr. STUART, M.P., contended that the paragraph of the report complained of by Lord Onslow was a fair representation of what took place. After describing the proceedings in the House of Commons, he said that the Council had not lost any time in bringing the whole matter of the water question to a conclusion as soon as possible. Towards this conclusion they were trending when the Government intervened with a measure which was a new one, which many in the Council were anxious to support, but which certain of them could not but think was something put up to be knocked down, and was a form of dealing with the question which was altogether wrong. He contended that the solution of the question was postponed by the action of the Government; and he felt sure the ratepayers of London would acquiesce in the course he had taken in the matter in endeavouring to prevent the Government handing over a huge sum of money to the Water Companies in excess of what they were entitled to receive.

After some further discussion,

Mr. T. M'KINNON WOOD (the Chairman of the Joint Committee), replying to a number of questions, said that, by a majority of 16 to 8, the Committee approved of Mr. Stuart's action. As to the concluding paragraph of the report, he had no intention of withdrawing it. He was anxious that London should understand how large a section of the Moderate party endorsed the action of the Government in suggesting the purchase of the Water Companies' undertakings upon extravagant terms. He felt the ratepayers would not have the slightest difficulty in determining who had really stood as their staunchest friends in this matter.

The Earl of ONSLOW expressed regret that the terms of his motion in Committee should have been communicated to the Press without the subsequent resolutions which were carried.

The Council then divided, when there voted—For the amendment, 45; against it, 51—majority against, 6. The report, which did not contain any recommendation, was then received.

THE THAMES CONSERVATORS AND THE PURITY OF THE RIVER.

The Water Companies' Money Contributions.

It is satisfactory to find, from the last quarterly report to the Oxfordshire County Council by Colonel Blunt, one of the Conservators of the Thames, that the latter body are taking very active measures for preserving the purity of the river. He points out that the Act of Parliament under which the Conservators discharge their duties makes it an offence to open into any tributary a drain, channel, or pipe whereby sewage matter, whether solid or fluid, shall or is likely to flow or pass into the Thames or such tributary. These were the orders the Conservators had to fulfil, and for the carrying out of which they received a large annual payment from the Water Companies. They had not only to prevent any noxious matter passing into the Thames or into any tributary, but to guard against any possibility or danger of such pollution reaching a tributary, though in reality it might not occur. The Conservators were anxious to carry out their duties with as little hardship to individuals as possible. He thought the fact that in one case only had a prosecution been necessary, was evidence of their desire to give time for the requisite works; and the many instances where works cutting off the drainage had been satisfactorily executed, testified to the loyalty with which the requirements under the Act, harsh though they might seem to be, had been complied with. A marked improvement in the river water for London had resulted; and a more wholesome supply had been afforded to other places deriving their water for domestic purposes from the Thames or its tributaries. The Parish and District Councils in the area over which the Conservators can exercise their powers have received notice that surface water, soapsuds, and other household refuse, must not be discharged into the tributaries of the Thames; and in many cases this order has given rise to much opposition. For instance, the Maidenhead Town Council have passed a resolution protesting against being compelled to enforce regulations for the prevention of pollution of the Thames, in order that pure drinking water may be provided for the inhabitants of London; such regulations being, they say, both harassing to the inhabitants and expensive to the ratepayers of the Upper Thames, who derive no corresponding benefit. The Council trust that at an early date a new source of water supply may be found for London. An attempt to pass a similar resolution at a meeting of the Wokingham District Council proved abortive. Captain O. Young pointed out that it would be much better to remain neutral, because £25,000, or some such amount, was being paid for the water taken by the Water Companies; and it was, he said, only natural and just that, in return, the Companies should require the water to be kept clear for them. Besides, if the Companies were driven to obtain their water from other sources, they would, of course, cease to contribute the large amount they now paid towards the maintenance of the river and district; and as the tolls would be only sufficient to keep up navigation, the whole area would have to be rated. Indeed, directly they lost the Water Companies, they at Wokingham would be almost certain to have a rate to meet the loss of income that would be the result. The Cookham District Council, and one or two other local bodies, have sided with the opposition against the Conservators; but, from the tone of the discussions at the meetings of the opposing authorities, it is quite evident that the point indicated by Captain Young has not presented itself to the local legislators—the prevailing opinion being that the Water Companies are getting something for nothing. This, of course, is altogether erroneous, as the Companies make very substantial payments for what they receive, and have therefore a right to demand what the Conservators are endeavouring to bring about—viz., the non-pollution of the Thames and its tributaries.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Sheriff Comrie Thomson, of Forfarshire, has disposed of the appeal to him by the defenders against his Substitute's decision in the actions by Mr. Alex. Philip and Provost Vallentine, of Brechin, against the Brechin Gaslight Company. The pursuers, it will be remembered, having refused to pay the full price for the gas consumed by them, the Company threatened to cut off the supply from their houses. Then actions were brought to have the Company interdicted from cutting off the gas. Sheriff-Substitute Robertson granted interim interdict, and allowed both parties a proof of their averments. This decision the Sheriff Principal has reversed; refusing interdict, and finding the Gas Company entitled to their expenses, in both actions. His Lordship's opinion is to the following effect: "It is somewhat surprising that so important a community as Brechin should be dependent for its gas supply upon a private company, which is not subject to the conditions and provisions of either a Public or a Private Act of Parliament. But so it is. The pursuer has used a certain amount of the defenders' gas; and he declines to pay for it because he thought (it may be rightly) that it was of an inferior quality. The defenders maintain that if he will not pay for the gas which they supply to him, they are entitled to refuse to let him have any more. I am of opinion that they were justified in this position. If the pursuer has used the gas, he must pay the ordinary price for it. If he does not think it good enough, he need not use it. And as he has practically intimated to the defenders that he will not pay for what he considers an inferior quality of gas, they are not bound to supply him for the future until they are reasonably assured he will not dispute their claim for payment." The decision is one of great interest in Scotland, where there are so many non-statutory companies. I do not think it has ever yet been disputed that such companies possessed the right which the Brechin Company tried to assert; but when it was questioned, it was well to have it decided promptly, which has been done so far as the Sheriff Court is concerned. There is, however, a right of appeal to the Court of Session; and as the parties who have lost are a Solicitor and the Provost of the town, it is possible they may try their luck there. The decision of the Court of Session would be final. I scarcely think they would win there, as I look upon Sheriff Comrie Thomson's view of the case as a sound one.

On Monday, the interesting ceremony took place of formally laying the foundation of the new chimney in the Edinburgh Gas-Works. Before the event, a short meeting of the Commissioners was held in the office of Mr. Mitchell, the Engineer, at which it was reported that it had been remitted by the Works Committee to a Sub-Committee to adjust the terms of contract with Messrs. Humphreys and Glasgow with reference to the introduction of their carburetted water-gas plant. A short conversation took place on the subject, in the course of which Bailie Kinloch Anderson intimated that Messrs. Humphreys and Glasgow's offer had been accepted. With regard to the chimney, it was reported that the Works Committee, having had reports submitted to them by Mr. Mitchell and Messrs. R. Bruce and Son, of Edinburgh, the contractors for the erection of the chimney, had agreed to the alterations proposed; and recommended the Commissioners to accept the estimate of the contractors for doing the extra work. This was agreed to. Now the occasion for the alteration arose in this way: It so happens that Messrs. Bruce and Son recently erected another chimney, which, on being brought into use, very soon developed defects. These, I suppose, have now been remedied; and the experience gained there was fortunately obtained in time to be of service in the erection of the gas-works chimney. The alterations consist in the enlargement of the flues, and the introduction of arrangements for assisting the draught. Although I have never made any use of it, I have known for some time that difficulty has been occasionally found in the working of regenerative furnaces, on account of the air-inlets not having been made of sufficient capacity to allow the waste gases to be consumed. A good deal of reconstruction has consequently been required; the very high heats developed in the wrong places having resulted in the weakening of the settings. It is rather a technical subject, however, and is therefore more suitable for consideration by managers than by me; the conditions varying according to the form of setting. Another item of business transacted by the Commissioners was the approval of a report by the Works Committee, to the effect that they had authorized Mr. Linton, the Engineer of their Leith works, to submit detailed specifications of new exhausters and engines to two makers named by him; and this having been done, and offers received, they had appointed a Sub-Committee to consider the tenders and to report.

The ceremony of laying the foundation bricks of the chimney took place in a pit 16 feet deep. In order to get a proper foundation, it was necessary to excavate 27½ feet, till rock was reached, which, though friable, is of sufficient density. One of the greatest difficulties which the contractors encountered was the underpinning of the southern boundary of the works, and of two pillars supporting the roof of the retort-house. This was successfully accomplished; and the excavation having been completed, a bed of concrete 7½ feet thick was put in. The foundation is considered to be in every way satisfactory, and

to be capable of bearing the weight of the brickwork, which is roughly estimated at about 3000 tons. The ceremony was a little out of the ordinary run of such affairs. In the first place, there was no glass case containing documents, coins of the realm, and so on, because they would soon be all melted. Then the article to be laid being the unheroic brick, instead of the imposing hewn stone which is usual on such occasions, and the laying of a single brick being but a trifling matter, it was resolved to procure a dignity for the celebration, which would have been otherwise wanting, by multiplying the honours. In all five bricks were laid; each with some approach to Masonic formula, though the ceremony was not a Masonic one. Bailie Kinloch Anderson, as Convener of the Works Committee, laid the centre brick; Lord Provost M'Donald, of Edinburgh, the north-east corner brick; Provost Bennet, of Leith, the south-east corner brick; Mr. Younger, the Convener of the Finance and Law Committee, the south-west corner brick; and Mr. Mitchell, the Engineer, the north-west corner brick. After the event, the Commissioners and guests adjourned, at the request of the contractors, to one of the new offices within the works, and partook of light luncheon.

It may not be out of place to state here that the old chimney is again in use. A temporary chimney was erected during the past summer, and was employed while the old one was allowed to cool down sufficiently to be examined. This was done; measurements and photographs having been taken. Mr. Cammack Dennis, of Bury, who conducted the examination, reported the chimney as being good for four or five years' service; and it is now doing full duty again. I understand it is not quite steady; but there is nothing alarming in its behaviour. The Commissioners, however, are anxious that it should be taken down as soon as possible, though it will be nearly a year before this can be accomplished. In the first place, it is expected the new chimney will not be completed before October; and then it will take several months before it can be brought into regular use, which must be done gradually.

The ratepayers of Monifieth, a recently constituted police burgh, near Broughty Ferry, met on Tuesday night to consider how they could best provide a system of lighting for the burgh. Last year they applied to the Police Commissioners of Broughty Ferry for the terms upon which they would supply gas. The quotation which they received they considered to be rather high; and since then a Committee has been inquiring into the matter of other illuminants. The result of these inquiries was stated by Mr. Barrie, the Convener of the Committee. They found, he said, that, taking leakage into account, if they had accepted the terms offered by the Broughty Ferry Police Commissioners, they would have been obliged to charge as much as 5s. 6d. per 1000 cubic feet for gas. Besides this, the Broughty Ferry Commissioners wished to bind them to preclude all other methods of lighting for the next 15 years, which they did not care to do, as they did not know what might transpire within that period. They believed they could erect a local gas-works for £2500, and sell gas for 4s. 6d. per 1000 cubic feet, or less. They had considered as to the fitting up of an electric lighting station; and were satisfied that it would cost £3500, and that they would be obliged to impose a charge equal to 5s. 3d. per 1000 feet for gas. An oil-gas works, they thought, could be erected for about £950, and the piping in the town would cost about £850; so that the total outlay would be less than for a coal-gas works. The Committee were of opinion that they should at once proceed with the erection of a local gas-works. A long discussion ensued; but in the end it was resolved to take no action in the meantime.

James M'Cullagh, one of the men who were sentenced in the High Court of Justiciary in Edinburgh, in 1883, to periods of penal servitude varying from 20 years to life, for the attempt to wreck, by dynamite, one of the gasholders at Tradeston, Glasgow, has been liberated from Portland Prison on the ground of ill-health. M'Cullagh's sentence was a life term. He is now residing in the Garngad district of Glasgow, which is on the other side of the city from Tradeston.

The Perth Gas Commissioners, in pursuance of their proposal to proceed with the construction of an additional gasholder, are inquiring into the modes of erecting holders without guide columns. A special meeting of the Commission was held on Monday, at which a deputation was appointed to visit Middlesbrough and Chester, and see holders which have been erected there. The Falkirk Gas Commissioners are also considering the same subject.

The Glasgow and West of Scotland Pharmaceutical Association were addressed, on the 19th ult., by Mr. Robert Locher, of Maybole, on "Coal and Coal Gas." The communication was largely descriptive, and contained nothing new except the following passage: "The poisonous, and consequently dangerous, constituent of coal gas is the methane or marsh gas, which, mixed with air, is the fire-damp of coal mines, and causes explosions. The after-damp is a mixture of nitrogen and carbonic acid." Surely Mr. Locker must either not have been well acquainted with his subject, or he has been misreported. Marsh gas may be highly dangerous, in respect that it is the constituent in gas which chiefly causes explosions; but that it is poisonous to a degree which makes it worthy of being singled out in the way he does, is not an accepted article of belief among those who supply gas.

The Greenock Water Trustees, and the millowners in the town, on Wednesday inspected the town water-works. At the luncheon which followed, Provost Shankland said that this was the twenty-ninth year of the existence of the Water Trust; and the annual revenue had increased from £11,000 to over £25,000. During the past year, the embankment of Loch Thom had been raised by 3 feet, which gave 25 days' supply for all purposes, and that at a very small cost. This, he stated, now placed them beyond all fear of want. Last year at this time there were 120 days' supply in store, compared with 182 days this year. Mr. R. Gilmour, the Engineer, said that the Trust had intended to raise the water-level of Loch Thom by putting on one 18-inch course of masonry at the waste weir; but after experiencing last year's drought, they decided to put on two courses, raising the water-level 3 feet. The increased capacity now available in Loch Thom was nearly 47 million cubic feet, which is equal to 25 days' supply to the mills, and it was exceedingly unlikely, now that there had been such a large addition made to the storage, that there would be any cause for anxiety about a scarcity of supply for a number of years.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 2.

Sulphate of Ammonia.—The market has been much depressed throughout the week; and sales have been made at £8 per ton, f.o.b. Hull, Liverpool, and Leith. Covering for March shipment being practically completed a week ago, export orders have been scarce; buyers being in no hurry in regard to their April requirements. The demand for home consumption continues on a satisfactory scale. With considerable supplies carried forward from March, makers show more anxiety to sell than has been the case for some time; and this may militate against an early recovery in price. The increase in exports to the end of the third week in March—7000 tons over those in the same period of last year—is a favourable feature in the situation; though the increase may be partly attributed to the early season. Encouraged by the depressed condition of the spot market, speculators are offering on the Continent at prompt prices up to June, and at a very small premium for the early autumn months.

Nitrate of Soda is fairly steady; the opinion being that, in face of ample supplies, an advance during the spring season can hardly be looked for. Holders, in consequence, are wishful to realize at current values. Spot price of fine quality is 8s. per cwt., and for due cargoes 7s. 10½d. per cwt.

LONDON, *April* 2.

Tar Products show no new feature of interest. Benzols are moderately steady at former quotations; but buyers still show some reluctance to purchase for forward delivery. There is a remarkable absence of stocks; and it is reported that some middlemen have considerably oversold themselves, particularly in nineties. The mild winter season, together with the great increase in the production of carburetted water gas, has seriously diminished the quantity of tar made; and this, it is expected, will soon make itself manifest in the short yield of products. Carbolic acid is still sought after, but not with the same eagerness. There is a fair business in naphthalene in its various forms. Anthracene is firm, with a pretty good inquiry from buyers. Pitch shows a slight recovery from its relapse; and it would not be surprising if higher prices obtained as the season advances. Makers have no stocks.

The following may be taken as the average price at which business has been done during the week, in most cases less 2½ per cent. Tar, 18s. to 23s. Pitch, 31s. to 34s. Benzol, 90's, 2s. 2d., prompt; 1s. 11d., forward; 50's, 1s. 8d. Toluol, 1s. 6d. Solvent naphtha, 1s. 2½d. Crude, 30 per cent., naphtha, 9½d. Creosote, 1d. Creosote salts, pressed, 48s.; drained, 27s. Cresylic acid, 1s. Carbolic acid, 60's, 2s. 2d.; 75's, 2s. 6d. Anthracene, "A," 10½d.; "B," 8d. to 9d.

Sulphate of Ammonia.—Notwithstanding the continually increasing shipments, and an excellent home consumption, market values do not improve. On the contrary, business has been done at £7 17s. 6d.; while not more than £8, less 3½ per cent., is obtainable at the moment at any other British port. The position is anomalous, especially having regard to the firmer value of nitrate of soda. Gas liquor is offered at 5s. 6d. to 6s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The holidays during the past week have necessarily interrupted the ordinary course of business in the coal trade here; and pits have been stopped in most cases since Thursday, and will only resume operations to-day, or, in some instances, to-morrow morning. Just for a few days prior to the stoppages of the pits, there was a little extra buying, in some qualities of fuel, to cover requirements over the holidays; but generally speaking, the position remains unchanged. House-fire coals have been in moderate request, for the reason stated above; and prices are fairly steady at late rates. Steam and forge coals still hang upon the market, with low prices ruling. At the pit mouth, best Wigan Arley averages about 10s. per ton with 10s. 6d. only obtained in exceptional cases; Pemberton four-feet and seconds Arley, 8s. 6d. to 9s.; common house-fire qualities, 7s. to 7s. 6d.; with steam and forge coals, for inland sales, not fetching more than about 6s. The better qualities of engine fuel have been meeting with a fairly active inquiry, consumers having shown rather an anxiety to cover their requirements for mill purposes over the Easter stoppages of the local collieries. Thus with supplies rather scarce, in some quarters, a hardening tendency in prices is noticeable; but it is only in exceptional cases where there is any actual advance on forward contracts. Common slack continues generally plentiful, and low in price. Pit prices remain at about 4s. 6d. up to 5s. for the best qualities, and 2s. 9d. to 3s. 3d. for common slack. The shipping trade shows no improvement either as regards prices or demand, with 6s. 9d. taken in many cases, and 7s. to 7s. 3d. the full average figures for ordinary steam coals delivered at the Mersey ports.

Northern Coal Trade.—The interruption of the holidays usually stiffens the coal trade; and this year is no exception to the rule. There has been a larger demand for steam coals; and the opening of the northern ports now will certainly give greater animation after the holidays. Best Northumbrian coals are quoted 7s. 9d. per ton f.o.b., for prompt delivery; and a higher price is asked for delivery over the season. Second-class steam are about 7s. to 7s. 3d. per ton f.o.b.; and steam smalls, 3s. 6d. to 3s. 9d. per ton. Manufacturing coal is rather easier—many of the factories being idle for the holidays. Household coals are very dull; the mild weather lessening the demand, and the competition among the land sale collieries being increased. In regard to bunker coals, there is rather a better demand. More steamers are now at work; while there is still a supply that is abundant, and that keeps the price weak at about 6s. 3d. per ton f.o.b. for unscreened qualities. Gas coals are steadily maintained in price; for though the local consumption is lessened, there is now a larger export of coals, and the opening of the Baltic ports will give a stimulus to the demand. The contract for the St. Petersburg gas coal supply has been allotted to a

Sunderland shipping firm; the price being about 10s. 2d. per ton at St. Petersburg. Another and a larger contract has yet to be decided on; and this will more accurately indicate the trend of the market. At the same time, it may be remarked that there is a growing feeling on the part of the miners against the long contracts that are being taken; and this may to an extent influence some coalowners. For odd cargoes of gas coals, the price now quoted varies from 6s. 3d. to 6s. 9d. per ton f.o.b. generally; but there are one or two large producers who ask higher rates than these. In the coke trade, there is growing activity. The local consumption of coke at the blast furnaces is the highest reported, and the demand for the north-western furnaces tends upwards. Coke exports are now beginning to increase; some sales having taken place for considerable quantities on contract. The price for best qualities is now 15s. to 15s. 3d. per ton f.o.b. There is no alteration in the price of gas coke; but the production is comparatively limited to what it was three months ago, and with a fair export stocks are being reduced.

Scotch Coal Trade.—There is no change to report, except that the volume of trade grows. Prices and demand remain the same for all varieties; the greatest run being still on small sorts. Prices quoted are: Main, 5s. 9d. per ton f.o.b. Glasgow; ell, 6s. 3d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; steam, 7s. 6d. The shipments for the week amounted to 128,730 tons—an increase of 4566 tons over the preceding week, and of 5214 tons over the corresponding week of last year. For the year to date, the total shipments amounted to 1,474,920 tons—an increase compared with the quantity in the same period last year of 151,487 tons.

The Water Supply of East Looe.—A meeting of the ratepayers of East Looe, Cornwall, was recently held for the further consideration of the proposals of the Trustees of the Town Charity respecting the extension of the water supply, to which reference was made in the "JOURNAL" for the 17th ult. (p. 590). Mr. A. Peter, the Chairman of the Trust, stated that the inquiry held by Mr. L. A. Selby Bigge, on behalf of the Charity Commissioners, had only strengthened the opinion of the Trustees that the management of the water supply should remain in local hands. Since the inquiry, the Trustees held a meeting, and decided to give a guarantee for the amount required to meet the interest and sinking fund of the proposed loan. This decision had been communicated to Mr. Bigge, who promised to hold over his report until he heard from them on this point; and he had now written in terms which led them to the conclusion that the loan would be sanctioned. Mr. H. Shapcott, the Honorary Secretary of the Trust, presented a statement of the financial position, showing the gradual but steady improvement of the property. Mr. T. H. Hicks replied to some local criticism of the water supply, and said that, though the present reservoir was small and open, it was neither fed by, nor contaminated with, surface water. A resolution expressing confidence in the Trustees, and asking the Charity Commissioners to sanction the loan, was unanimously carried.

A Water-Rate Difficulty.—A singular grievance has arisen with respect to the water supply recently provided for the little Cornish town of Boscastle. The town is situated in the parishes of Forrabury and Minster. The greater number of houses are in the former parish, which has a small area; while about two-thirds of the cost falls upon Minster—a straggling agricultural parish extending 3½ miles from Boscastle. The parishioners of Minster have been called upon to pay a water-rate of 5d. in the pound upon houses, and 1¼d. in the pound on land; while the house property of Forrabury bears a rate of only 3d. The farmers of the outlying district are much aggrieved, particularly as it was understood at the Local Government Board inquiry that the people who used the water would have to pay for it. Representations have been made to the Board; and the Camelford District Council have decided to petition them to exempt the land from the rate.

The Essex County Council and the Laindon Gas and Water Order.—At a meeting of the Essex County Council last Tuesday week, the subject of the above-named Order, which, as already mentioned in the "JOURNAL" (*ante*, p. 339), the Council had decided to oppose, on the ground of absence of definite information as to the parties applying for it, was under consideration. Mr. Davis, a solicitor, attended, and explained that the promoters were his clients; and they and their friends were prepared to find the major portion of the capital in the event of the Order being granted. A fully-signed petition in favour of the scheme had been presented from Billericay; and building plots had been sold on the Laindon Estate to about 300 purchasers. The local authorities had approved of the gas and water proposals; and, as an earnest of their *bona fides*, the promoters had already commenced operations. In the end, the Council withdrew their opposition.

A Water Supply Problem from North Bierley.—The "Bradford Observer" presents the following for the consideration of arithmeticians and experts in the science of commercial economics: The North Bierley district buys its water from the Bradford Corporation, and has only to distribute it, and charge accordingly. Nevertheless, there is emphatic disagreement among those concerned, not only as to what the distribution costs to large and small consumers respectively, but even as to whether the local works as a whole are carried on at a loss. The figures show that £2400 worth of water bought from the Bradford Corporation costs just about as much more to distribute. Therefore it would appear that 1s. 6d. per 1000 gallons (being double the cost price) should nearly pay. But more than one-third of the whole quantity taken is lost by leakage. This brings the cost price to the consumer up to nearly 2s. 6d. per 1000 gallons. The Board's charges vary from a maximum of 2s. 6d. per 1000 gallons for the smallest consumers down to 1s. 4d. for the largest. The controversy, therefore, is as to whether the price should be raised to the small consumers, who are presumably responsible for the greater part of the loss by leakage, and are otherwise the most costly, or to the large consumers, who seem to get water at less than the average price (1s. 6d.) at which the Board can possibly supply it without loss.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 742).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
592 000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	24½–25½	..	4 2 4
100,000	10	„	7½	Do. 7 p. c.	17–18	..	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	108–110	..	4 10 11
200,000	10	16 Oct.	4	Belgrano (B. Ayres), Limited	8½–9½	..	4 4 3
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	95–100	..	5 0 0
200,000	5	14 Nov.	6½	Bombay, Limited	7½–7¾	..	4 3 10
40,000	5	„	6½	Do. New, £4 paid	5¼–5½	..	4 10 3
380 000	Stck.	27 Feb.	12	Brentford Consolidated	280–285	..	4 4 3
210,000	„	„	9	Do. New	215–220	..	4 1 9
50,000	„	„	5	Do. 5 p. c. Pref.	—	..	—
159.375	„	16 Dec.	4	Do. 4 p. c. Deb. Stock.	127–132	..	3 0 7
220 000	Stck.	27 Mar.	11	Brighton & Hove Original	232–237†	+2	4 12 10
208,820	„	„	8	Do. A Ord. Stk.	182–187*	..	4 5 6
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	127–132	+4	3 15 9
420,000	20	27 Mar.	11¼	British	55–56*	..	4 0 4
50,000	10	12 Mar.	11¼	Bromley, Ordinary 10 p. c.	22½–23½	..	4 17 10
71 000	10	„	8½	Do. 7 p. c.	19–20	..	4 5 0
500,000	10	14 Nov.	4	Buenos Ayres (New) Limited	9½–10	..	4 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	102–104	..	5 15 5
150,000	20	27 Feb.	8½	Cagliari, Limited	29–31	..	5 6 5
100,000	10	27 Sept.	8½	Cape Town & District, Ltd.	13¾–14½	..	5 10 4
50,000	50	2 Nov.	6	Do. 6 p. c. 1st Mort.	57–59	..	5 1 9
550,000	Stck.	16 Oct.	13½	Commercial Old Stock	332–337	..	4 0 2
165,000	„	„	10½	Do. New do.	257–262	..	4 0 3
165,000	„	16 Dec.	4½	Do. 4½ p. c. Deb. do.	147–152	..	2 19 2
800,000	Stck.	16 Dec.	13	Continental Union, Limited.	278–283	..	4 11 10
200,000	„	„	10	Do. 7 p. c. Pref.	215–220	..	4 10 11
51,620	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	„	„	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p.c. Stk	130–135	..	3 17 9
60,000	„	„	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26–27	..	4 1 6
354,060	10	„	11	Do. £7 10s. paid	17½–18½	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	297–302	+2	4 4 6
100,000	„	„	4	Do. B, 4 p. c. max.	103–113	..	3 10 9
665,000	„	„	10	Do. C, D, & E, 10 p.c. Pf.	288–293	..	3 8 3
30 000	„	„	5	Do. F, 5 p. c. Prf.	140–145	..	3 9 0
60,000	„	„	7½	Do. G, 7½ p. c. do.	205–210	..	3 11 5
1,300,000	„	„	7	Do. H, 7 p. c. max.	200–205	..	3 8 3
463,000	„	„	10	Do. J, 10 p. c. Prf.	287–292	..	3 8 6
476,000	„	„	6	Do. K, 6 p. c. Prf.	163–172	..	3 9 8
1,061,150	„	16 Dec.	4	Do. 4 p. c. Deb. Stk.	138–142	..	2 16 4
294,850	„	„	4½	Do. 4½ p. c. do.	148–153	..	2 18 9
908,000	„	„	6	Do. 6 p. c. do.	204–209	..	2 17 5
70,000	10	30 Oct.	6	Hongkong & China, Limited	13–14	..	4 5 8
3,800,000	Stck.	14 Nov.	12	Imperial Continental	250–254	..	4 14 5
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100–103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk „	108–110	..	3 3 8

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6–6½	..	4 12
560 000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	113–116*	+½	4 6 2
250,000	100	„	4½	Do. 4½ p. c. Debs.	107–109*	..	4 2 7
541,920	20	14 Nov.	5	Monte Video, Limited	17–18	+½	5 11 1
150,000	5	28 Nov.	8	Oriental, Limited	8½–8¾	..	4 11 5
135,000	5	„	8	Do. New, £4 10s. paid	7½–7¾	..	4 12 10
15,000	5	„	8	Do. do. 1879, £1 paid	1¾–2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	4¾–5¼	..	6 13 4
166,870	10	—	2	Para, Limited	1–1½	..	—
420,000	100	2 Nov.	6	People's Gas 1st Mtg. Bds.	105–110	..	5 9 1
500,000	100	9 Dec.	6	of Chicago 2nd Do.	100–105	..	5 14 3
250,000	10	27 Mar.	8½	San Paulo, Limited	12½–13½†	..	5 11 1
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	387–392	..	3 19 1
1,350,000	„	„	12	Do. B do.	312–317	+2	3 15 8
310,000	„	„	13	Do. C do.	327–332	..	3 18 5
800,000	„	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175–178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250–255	..	4 10 2
60,000	„	„	8½	Do. B	—	..	—
170,380	10	30 Dec.	10	Tuscan, Limited.	13–14	..	7 2 10
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100–102	..	4 18 0

WATER COMPANIES.

746,021	Stck.	30 Dec.	10¼	Chelsea, Ordinary	323–328	..	3 2 6
150,000	„	„	5	Do. 5 p. c. Pref.	170–175	..	2 17 1
160,000	„	„	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,783	„	27 Mar.	4½	Do. 4½ p. c. Deb. Stock	155–160*	..	2 16 3
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	250–255	..	2 14 10
654,740	„	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	155–160	..	2 16 3
100,000	„	„	3	Do. 3 p. c. Deb. Stk.	105–107	..	2 16 1
700,000	50	16 Dec.	6½	Grand Junction, 10 p.c. max.	127–132	..	2 9 3
280,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	148–152*	..	2 12 8
708,000	Stck.	13 Feb.	12	Kent	332–337	..	3 11 2
160,000	„	„	7	Do. New, 7 p. c. max.	207–212	..	3 6 0
1,043,800	100	30 Dec.	7½	Lambeth, 10 p. c. max.	274–279	..	2 11 11
405,200	100	„	7½	Do. 7½ p. c. max.	227–232	+2	3 2 6
330,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	147–152*	..	2 12 8
500,000	100	13 Feb.	12¾	New River, New Shares	420–430	..	2 19 3
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	153–158	..	2 10 8
902,300	Stck.	16 Dec.	6	S'thwk & V'xhall, Ordinary	168–173	–2	3 9 5
126,500	100	„	6	Do. Do. 7½ p. c. Max.	155–165	..	3 12 9
489,200	Stck.	„	5	Do. Do. 5 p. c. Pref.	168–173	..	2 17 9
1,019,585	„	—	4	Do. 4 p. c. A Deb. Stk.	147–152	..	2 12 8
1,155,066	Stck.	16 Dec.	10	West Middlesex	312–317	+2	3 3 1
200,000	„	„	4½	Do. 4½ p. c. Deb. Stk.	155–160	..	2 16

*Ex div.

†Next dividend will be at this rate.

Kimberley Water-Works Company, Limited.—The report of this Company for the past year shows a balance of £20,119. After providing for debenture interest, the net available profit is £13,919. The Directors propose to write off £2514 from the construction account, to transfer £3529 to the contingency fund, and to pay a dividend of 2½ per cent. for the year.

Good Water Supply v. Electric Lighting at Madeira.—The recent death from enteric fever of the wife of the English Consul in Madeira has had the effect of directing attention to the water supply, on which subject Dr. Longstaff, writing from Funchal on the 16th ult., had a letter in *The Times* last Thursday. It appears therefrom that the water is "conveyed to the town in open channels, in which clothes are habitually washed, and which are liable to every sort of pollution." There are wells and springs in the centre of the town, the chief of which has, however, been recently closed in consequence of microscopical examination having revealed in its waters the bacillus of enteric fever. Dr. Longstaff says the medical men of the place are constantly insisting on the evils of this state of things; and the hotel-keepers, who have spent large sums of money on perfecting their sanitary arrangements, are careful to supply their guests with boiled water and milk. It seems that only some three or four miles of iron pipes would be required to convey to the heart of Funchal an abundant supply of pure mountain water. No engineering difficulties have to be overcome, but simply the inertia of the authorities. Dr. Longstaff says the island is, no doubt, poor; but he points out that a good water supply would benefit it in many ways, and greatly increase the number of visitors. Instead of turning their attention to this vital question, the Municipality appear to think that, like moths, visitors are to be best attracted by a costly electric light installation—with the possible result, carrying on the simile, of meeting their own destruction.

The Price of Gas at Teignmouth.—Another abortive attempt has been made to find a solution for the troubles of the Teignmouth District Council with respect to the management of the gas-works. In accordance with the ruling of the Clerk, Mr. G. H. Jarvis, who is desirous of getting the price increased, gave notice of a motion to rescind a former resolution of the Council, by which the charge was fixed at 3s. 9d. per 1000 cubic feet. A special meeting of the Council was called to consider this motion; but as Mr. Jarvis was not present at the time for which the meeting was convened, the Chairman (Mr. T. W. Hutchings) proceeded with the ordinary business. Subsequently Mr. Jarvis arrived, and wished to move a resolution of which he had also given notice to increase the price of gas. The Chairman, however, ruled him out of order. Mr. Jarvis, in the course of a brief speech, contended that there was great financial leakage at the gas-works, which instead of being a relief to the town were a burden to it. The Council were now paying 2s. a ton more for coal than they ought to pay; so that on their consumption of 2000 tons there was a loss of £200. In addition, they were paying too high a freight, and 5 per cent. interest on the overdue coal account, while they were often out of coal, and consequently obliged to use whatever "rubbish" anyone might like to send them. Their wages were also too high. The Council, he added, were a laughingstock in this matter, for there were no gas-works in the British empire, except those at Teignmouth, which did not pay a dividend. The Chairman denied the statement that 5 per cent. interest was paid on overdue coal accounts; and, replying to Mr. G. Sercombe, who said that there was a leakage of 25 per cent. owing to defective mains, he contended that the leakage had been reduced. Mr. Sercombe proposed that the Gas Committee should furnish the Council, not later than May, with a comprehensive report upon the works, showing the cost of production, &c. Everything, he said, was straight and above-board; and the books were properly kept. The Council, however, were entitled to know the cost of production. This proposition was carried.

Bridgwater Corporation Water Supply.—The Bridgwater Corporation have recently put down a new turbine and additional pumping machinery at their water-works at Ashford, at a cost of between £600 and £700. A formal inauguration of these additions took place on Monday last week. The new machinery was set in motion by the Mayor (Alderman Pollard), who afterwards presided at a luncheon provided at his own expense.

West Gloucestershire Water Company.—During the half year ended Feb. 29, this Company connected to their system nearly 150 additional services, which bring the number of properties supplied up to 5227, producing, with some meter and miscellaneous supplies, an estimated revenue of £4158. The net profit of the past half year was £798; and the disposable balance is £805, which allows of the payment of a dividend at the rate of 2¾ per cent. per annum.

Additional Capital for the Barnstaple Gas Company.—A special general meeting of the Barnstaple Gas Company was held last Tuesday to authorize the raising of £12,000 by the issue of ordinary shares or stock or preference shares or stock in accordance with the Provisional Order of 1895. Mr. W. C. Rafarel, the Chairman, who presided, explained that £12,000 was the full amount allowed by the Order, but that it was only proposed to raise as much as would cover the cost of works which were at present executed. In reply to questions, the Chairman added that the works would cost about £4000; and he said it was not intended to pay off the mortgage of £4000 out of the new capital. The necessary resolution was unanimously adopted.

Johannesburg Water-Works Company, Limited.—The annual meeting of the shareholders in this Company was held at Johannesburg on the 16th ult.—Mr. S. B. Joel in the chair. The Directors in their report stated that the result of the past year's working had been most satisfactory. The Company's operations had resulted in a profit for the year of £40,300, in addition to £15,000 derived from the sale of leases and stands. The Company have recently acquired the water rights over the Weltevreden Farm, which alone will give a supply of 2 million gallons daily; and the contractors are under heavy penalties to complete this supply by the end of the present month. In addition, the Company have purchased the freehold of the Stienkoppies Farm, with an unlimited supply of pure water; and works are now being proceeded with, at a cost of £200,000, to connect these supplies. This, it is stated, places the Company entirely beyond competition.

Bognor Water Company.—The annual general meeting of this Company was held on Friday, the 27th ult.—Captain Hills, R.N., in the chair. The report of the Directors showed an income from water-rentals of £1746—being an increase of £360 on that of the preceding year; and a profit on the year's working of £675. The Directors recommended the payment of a dividend on the preference shares at the rate of 3 per cent. per annum. It was stated that the debenture stock had been further brought down by the payment of £1600—leaving a present liability under that head of £3000; and that the interest had, with the consent of the debenture-holders, been reduced from 5 to 4 per cent. per annum. The permanent works are now practically completed. In moving the adoption of the report, the Chairman said that last year the expenses were rather heavy, owing to exceptional expenditure for water; but that this year they would be much reduced. Mr. A. T. Long, in seconding the motion, said they had had twenty years of rough work; but they appeared to be now getting into smooth water. Mr. Pratt thought the money belonging to the old shareholders which had been expended in boring operations ought to be returned to those shareholders. The Chairman said if the Company had not been reconstructed, and had not pursued the course they did, the old shares would not have been of any value—indeed, the Company would have come to an end. The report was adopted.

GWYNNE & BEALE'S

PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 65,095.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

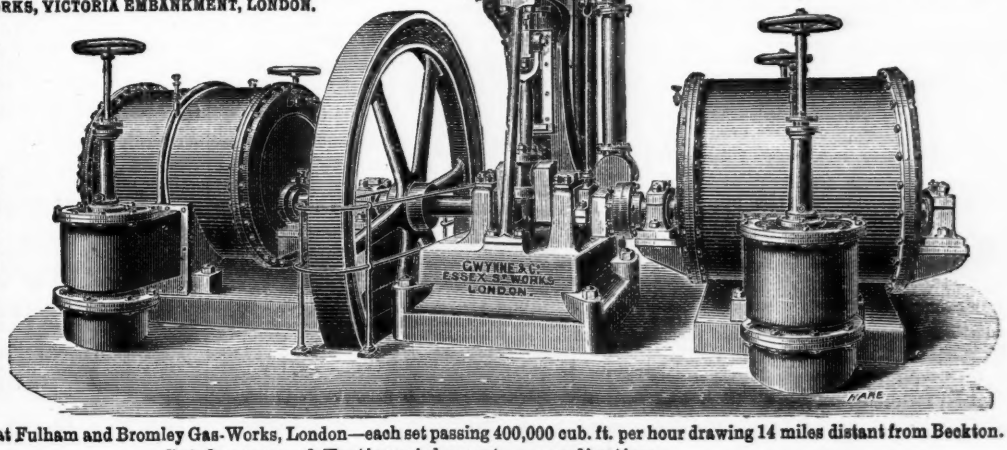
They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

Their Exhausters can be made, when desired, on their New Patent Principle to pass Gas without the slightest oscillation or variation in pressure.

MANY SIZES OF EXHAUSTERS KEPT IN STOCK.



Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

Catalogues and Testimonials sent on application.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
JOHN WM. O'NEILL, Managing Director,
Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications *re* Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works.
ANDREW STEPHENSON,
182, GRESHAM HOUSE,
OLD BROAD STREET,
LONDON, E.C.
Telegrams: "Volcanism, London."

AMMONIACAL LIQUOR Wanted.
BROTHERTON AND CO., Ammonia Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.
BROTHERTON AND CO., Tar Distillers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.
BROTHERTON AND CO., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHURIC ACID for Sale.
BROTHERTON AND CO., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS.
Correspondence invited.

R. ANDREWS, Practical Retort-Setter, has NOT RETIRED from Business, as reported. RETORT SETTING in all its Principles and Branches. Established 1864.
Address 67, Sugden Road, Lavender Hill, LONDON, S.W.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. 670, last week's issue.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and adroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER LINCOLN."

JOHN SHAW & CO., Cast-Iron Pipe Founders, Maryhill Iron-Works, Glasgow, will in future be REPRESENTED IN LONDON by their Junior Partner, Mr. HUGH GIRVAN, at 6, LOMBARD COURT, E.C.

In Paper Covers, Post Free 2s.

STEPHEN CARPENTER, of the Bow Common Gas-Works, on the Purification of Coal Gas by Lime, Oxide of Iron, and Atmospheric Air, and the Method of Working Purifiers so that the Lime may be used a second time, with a description of Carpenter's short Method of working off the Sulphur Test and Table for calculating Results.
S. & H. W. CARPENTER, 3, Bedford Villas, Carshalton, SURREY.

TO GAS COMPANIES MAKING SULPHATE OF AMMONIA.

THE Use and Value of Sulphate of Ammonia as Manure—A Leaflet, suitable for Distribution among the Farmers of their respective Districts, by WILLIAM ARNOLD, F.S.I., Land Agent, Rating Surveyor, and Valuer (late Chairman of the Tamworth Gaslight and Coke Company); together with valuable Formulæ, Rotation of Crops and Manures for the same, intended for the use of Tenant Farmers and others interested in Land, and to promote the sale of Sulphate of Ammonia for the production of Corn and other Crops by English Gas Companies.
Prices: 100 Copies, 10s.; 250 Copies, £1 2s. 6d.; 500 Copies, £2; 1000 Copies, £3 15s.
LONDON: WALTER KING, 11, Bolt Court, FLEET STREET.

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.
*** See Advertisement p. II., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

It is Worth Your While to Buy
DIRECT.
THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.
RELIANCE LUBRICATING OIL COMPANY, WATER LANE, GREAT TOWER, LONDON, E.C.
Depôts at Liverpool, Bristol, Hull, Glasgow, and Newcastle-on-Tyne. Telegrams: "Subastral, London."

WANTED, an efficient Man as Main and SERVICE LAYER and BLACKSMITH. Permanent Situation for good Man.
Applications, stating Age and Wages, to be sent to the MANAGER, Gas-Works, SOWERBY BRIDGE.

MAINLAYER.

WANTED, a Working Foreman, to carry out large extension of Water-Mains. Wages 50s. per week.
Applications, stating Age and Experience, accompanied with three Copies of Testimonials (which will not be returned) as to ability, &c., to be sent to the undersigned, on or before the 16th inst.
HAMLET ROBERTS,
Water-Works Engineer.
Ipswich, April 2, 1896.

GAS PLANT FOR IMMEDIATE SALE.

THE Willenhall Gas Company, having discontinued the Manufacture of Gas at their Works in Lower Lichfield Street, Willenhall, Staffordshire, have the following GAS PLANT for Sale, viz.—
TELESCOPIC GASHOLDER. Outer Lift, 45 ft. by 18 ft.; Inner Lift, 43 ft. by 18 ft. Cast-Iron Columns. Capacity, 53,390 Cubic Feet.
Two TELESCOPIC GASHOLDERS. Outer Lift, 60 ft. by 18 ft.; Inner Lift, 58 ft. by 18 ft. Cast-Iron Columns. Capacity of each, 94,425 Cubic Feet.
STATION METER, to pass 15,000 Cubic Feet per hour; 10-inch Connections. Hydraulic Valves by J. & J. Braddock.
WASHER (Kirkham, Hulett, and Chandler), to pass 250,000 Cubic Feet per day; 8-inch Connections.
ANNULAR CONDENSERS (Walker), to pass 250,000 Cubic Feet per day; 12-inch Connections.
GOVERNOR, 12 inches diameter, with 12-inch Connections, and Bye-Pass, by J. & J. Braddock.
Five Ton WEIGHBRIDGE; two EXHAUSTERS (by Jones), to pass 8000 Cubic Feet per hour; 15 by 16 inch MOUTHPIECES (Morton's Patent); ASCENSION-PIPES, &c.
For further Particulars, apply to J. C. Belton, Manager.
A. MARSTON, Secretary.
Gas Offices, Willenhall.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. Sample and Price on application.
OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore, Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c. CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special Attention to Repairs.
Before placing Orders, please write for Estimate.

REPORTS OF GAS ASSOCIATIONS.

A FEW complete Sets of the Reports OF GAS ASSOCIATIONS from 1883 to 1894, twelve Volumes) may be obtained of the PUBLISHER of the "JOURNAL," *Price* 30s., *cash with order*. The Volume for 1895 (or single copies of previous Volumes) 5s. 6d. *post free*.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 30, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEWBATTLE, DALKEITH, }

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

THE LAW GUARANTEE & TRUST SOCIETY, LD.
GUARANTEES FIDELITY.

SEND for complete Prospectus containing Balance-Sheet, Copy of Policy, &c., &c. Mortgage, Debenture, License, and Contingency Insurance.
Head Office: 49, CHANCERY LANE, LONDON, W.C.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

ECONOMY IN PURIFICATION.

INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.
References and Particulars can be obtained from the Makers—
C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.
And J. EVERY & SON, Phœnix Iron-Works, LEWES.

FOR SALE—One Station Meter, 6000 cubic feet capacity, by J. & J. Braddock, Oldham, in first-class condition; also one good 10,000 cubic feet STATION METER, by Parkinson, London.
Apply Box 19, Post Office, ACCRINGTON.

WALLASEY GAS AND WATER WORKS.

TO COAL MERCHANTS AND OTHERS.

THE Wallasey Urban District Council are prepared to receive TENDERS for the supply of about 20,000 Tons of CANNEL and GAS COAL for their Gas-Works, delivered in Waggons at Duke Street, Birkenhead, separately, for One, Two, or Three Years from the 30th of June next.

Specifications and any further Information may be obtained on application to the Engineer at the said Works.

Sealed tenders, addressed to the Chairman of the Gas and Water Committee, and endorsed "Tender for Coal," to be left at my Office, as below, not later than Four o'clock in the Afternoon of Thursday, the 23rd inst.

The Contractor will be required to enter into a bond, with approved sureties, for the due performance of the contract.

The Council do not bind themselves to accept the lowest or any tender.

By order,
W. DANGER,
Clerk to the Council.
Public Offices: Egremont, Cheshire,
April 2, 1896.

GAS PLANT, BUILDINGS,
AND
FREEHOLD LAND AT CARSHALTON, SURREY,
FOR IMMEDIATE SALE.

THE Croydon Commercial Gas and Coke Company, having discontinued the Manufacture of Gas at their Works in Wrythe Lane, Carshalton, Surrey, have the following GAS PLANT, APPARATUS, BUILDINGS, and FREEHOLD LAND FOR SALE, viz.—

Retort-House and Coal-Store complete, with Wrought-Iron Roofs, six Beds of six Round Fire-Clay Retorts in each, 18 inches diameter by 9 ft. 3 in. long, and three Beds of similar new Retorts and Arches, and three Arches, complete, ready for Retorts.
Hydraulic Mains, Fittings, &c.
Horizontal Steam-Engine, Exhauster, and Exhauster Governor, complete.
Washer (Good's Patent), 8 feet diameter, with 12-inch Connections and Valves complete.
Washer, 12-inch, with 6-inch Connections and Valves complete.
Four Purifiers, 12 feet square, with Sieves and 12-inch Connections, Lifting Apparatus and Railway for same, complete.
Station Meter, 10,000 cubic feet per hour, with 12-inch Connections.
Gasholder (Single-Lift), 80 feet by 24 feet, with Brick Tank, Columns, Inlet and Outlet Valves complete, prepared for Telescoping.
Gasholder (Single-Lift), 60 feet by 16 feet, Standards, Brick Tank, &c.
Gasholder, 35 feet by 12 feet, Standards, Brick Tank, &c.
Governor, 12 inches diameter, with 12-inch Valves and Bye-Pass complete.
Evans Photometer, Clock, Gauges, &c., complete.
House and Offices, Engine and Boiler House, Meter-House, Lobby and Store-Room, Governor-House and Testing-Room, Purifying House and Shed, Smith's Shop.
Freehold Land, 3 acres, 0 roods, 37 perches (about 2 acres not built upon).

Orders to view the Plant and Works, and Particulars of Prices the Company require for the whole or any portion of the above, can be obtained on application to

W. J. RUSSELL,
Secretary.

Offices: Katharine Street, Croydon,
March, 1896.

TO BUILDERS AND RETORT SETTERS.

THE Gas Committee of the Corporation of Evesham invite TENDERS for ALTERATIONS to their RETORT-HOUSE, for BUILDING RETORT-ARCHES, REGENERATIVE FURNACES, RETORT-SETTINGS, and for the supply of MATERIAL and LABOUR.

The Drawings and Specification may be seen on application to Mr. Fletcher, Manager, Gas-Works, Evesham; or to Mr. W. North, at the Gas-Works, Stourbridge.

Sealed tenders, endorsed "Retort-Benches, &c., Contracts Nos. 1 and 2," to be addressed to the Chairman, Gas Committee, Evesham; and sent so as to reach me not later than Noon on Thursday, the 16th day of April, 1896.

None but those who have had experience in the Building of Regenerative Furnaces need apply.

The Committee do not bind themselves to accept the lowest or any tender.

THOMAS COX,
Town Clerk.

Town Hall, Evesham,
April 1, 1896.

TO ENGINEERS AND IRONFOUNDERS.

THE Gas Committee of the Corporation of Evesham invite TENDERS for the supply and fixing of Sundry CAST and WROUGHT IRON and STEEL MOUNTINGS for RETORT-BENCHES, &c.

The Drawings and Specification may be seen on application to Mr. Fletcher, Manager, Gas-Works, Evesham; or to Mr. W. North, at the Gas-Works, Stourbridge.

Sealed tenders, endorsed "Retort-Bench Mountings, &c., Contract No. 3," to be addressed to the Chairman, Gas Committee, Evesham, and sent to me not later than Noon on Thursday, the 16th day of April, 1896.

The Committee do not bind themselves to accept the lowest or any tender.

THOMAS COX,
Town Clerk.

Town Hall, Evesham,
April 1, 1896.

BARRY URBAN DISTRICT COUNCIL.
(GAS AND WATER DEPARTMENT.)

THE Gas and Water Committee invite TENDERS for the surplus TAR produced at their Gas-Works for One Year ending March 31, 1897.

Approximate quantity: 40,000 to 45,000 gallons.

The Tar will be pumped into Contractor's Tank-Trucks at the Gas-Works Siding.

Tenders, endorsed "Tender for surplus Tar," stating Price per ton of 20 cwt., to be addressed to the Chairman of the Gas and Water Committee, on or before the 16th inst.

The Committee do not bind themselves to accept the highest or any tender.

Gas-Works, Barry, Glamorgan,
April 2, 1896.

COUNTY BOROUGH OF BURY.

TO SULPHURIC ACID MAKERS.

THE Gas Committee of the Bury Corporation are prepared to receive TENDERS for the supply of about 350 Tons of SULPHURIC ACID for the Manufacture of Sulphate of Ammonia, for a period of One Year from the 1st of May, 1896.

Forms of Tender and Conditions may be obtained on application to Mr. W. H. S. Gendall, Engineer and Manager, Gas-Works, Elton, Bury.

Sealed tenders, endorsed "Tender for Acid," to be sent to me, the undersigned, on or before Monday, April 20, 1896.

Preference will be given to those persons or firms who pay to their workpeople the regular standard rate of wages obtaining at the time in the town or district.

JOHN HASLAM,
Town Clerk.

Corporation Offices, Bury,
April 1, 1896.

NEW MILL URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the above Council invite TENDERS for the Supply and Delivery of—

(1.) 690 yards of 6-inch MAINS, Turned and Bored and Coated. Weight per Pipe, 2 cwt. 2 qrs. Also Sundry SPECIALS. Prices to be per ton for Pipes and Specials.

(2.) For the Supply and Erection of a RETORT-BENCH of Two Settings complete, with all Iron-work complete.

Full Particulars, with Plans, Specifications, and Quantities, to be seen on Application to the Gas Engineer, Mr. Edward Jones, Town Hall, New Mill.

Copies sent on payment of 10s. (not returnable).

Sealed tenders, to be endorsed "Retort-Bench," or "Cast-Iron Pipes," as the case may be, to be sent to the undersigned not later than April 11, 1896.

The Committee do not bind themselves to accept the lowest or any tender.

(Signed) JOSEPH POLLITT,
Clerk.

Town Hall, New Mill,
March 30, 1896.

COUNTY BOROUGH OF WIGAN.

THE Gas and Electric Lighting Committee invite TENDERS as follows:—

Contract No. 1. Cast Mains and Connections.
" " 2. Wrought-Iron Tube and Fittings.
" " 3. Brass Tube and Fittings.
" " 4. Lead Pipe.
" " 5. Firing and Charging Shovels.
" " 6. Brooms.
" " 7. Wood Troughing and Covering.
" " 8. Galvanized Stove Pipe and Connections.
" " 9. Bar Iron.

The Contracts will be for One Year, commencing on the 1st of April, 1896, and ending on the 31st of March, 1897.

Forms of Tender to be obtained from the undersigned.

The Committee do not bind themselves to accept the lowest or any tender.

Tenders, sealed and endorsed with the name of the articles tendered for (a sample of which must accompany each tender), to be delivered to J. J. Charnock, Esq., Town Clerk, Town Hall, Wigan, on or before Monday, the 13th of April next.

JOS. TIMMINS,
Engineer.

Gas-Works, Wigan,
March 25, 1896.

WATH-ON-DEARNE GAS COMPANY.

THE Directors of the above Company invite TENDERS for TELESCOPING a SINGLE-LIFT GASHOLDER, 60 feet diameter by 18 feet deep, at their Gas-Works, Wath-on-Dearne (Yorks).

Specifications, Drawings, &c., can be seen (or full copies be had on payment of 10s. 6d.) at the Office of the Engineer, Mr. Matt. Dunn, Assoc.M.Inst.M.E., Gas-Works, Selby.

Sealed tenders, endorsed "Tender for Gasholder, to be sent to the undersigned not later than Wednesday, the 15th day of April, 1896.

The Directors are not bound to accept the lowest or any tender.

By order,
T. CLARK,
Secretary.

Gas-Works, Wath-on-Dearne,
March 24, 1896.

NORTHWICH GAS COMPANY.

TENDERS are invited for the supply and delivery at Northwich Railway Station of about 4000 Tons of GAS COAL (screened, unscreened, or nuts), and about 250 tons of CANNEL during the Year ending June 1, 1897.

TENDERS are also invited for the supply and delivery of LIME and SULPHURIC ACID during the same period.

Any further Particulars required may be had on application to Mr. S. S. Mellor, the Manager.

The lowest or any tender not necessarily accepted.

Tenders, endorsed and addressed to the Chairman, must be delivered here not later than Nine a.m. on Saturday, April 11, 1896.

HENRY PICKERING,
Secretary.

Gas Office, Northwich,
March 27, 1896.

CITY OF LEEDS.
(GAS DEPARTMENT.)

TENDERS are required as below:—

For Turned and Bored and other PIPES, BENDS, TEES, SYPHON WELLS, and other IRREGULAR PIPES.
For Brass MAIN COCKS.
For 2½-inch, 3-inch, and 4-inch Self-Faced BRADFORD or HALIFAX FLAGS.
For RETORT-MOUTHPIECES, STAND-PIPES, DOOR-FRAMES, SPECIAL BENDS, TEES, FLANGE PIPES, &c.

Samples may be seen on application at the Stores Department, 21, Dewsbury Road; and Forms of Tender and Specification may be had on application to the undersigned.

Endorsed tenders, addressed to the Chairman of the Gas Committee, Municipal Buildings, Leeds, will be received not later than Wednesday, the 15th inst.

The Committee do not bind themselves to accept the lowest or any tender.

R. H. TOWNSLEY,
General Superintendent.

Municipal Buildings, Leeds,
April 4, 1896.

By Order of the Directors.

TO TRUSTEES, INVESTORS, AND OTHERS.

NOTICE OF SALE BY AUCTION BY

MESSRS. CRAWTER, at the Cock Inn, Waltham Abbey, on Tuesday, April 21, 1896, at Five o'clock, of 125 SHARES of £10 each, known as "C" Shares, in the WALTHAM ABBEY AND CHESHUNT GAS AND COKE COMPANY, which, at the present Price of the Gas sold by the Company, are entitled to a Dividend, when earned, of 10½ per cent.

The Shares rank for Dividend equally with the existing £5000 Additional Capital authorized by the Company's Act, 1869, known as "B" Shares, on which a Dividend of 5 per cent. per annum has for many years past and up to the present been paid; thus offering an investment which must increase in value.

Particulars and Conditions of Sale may be obtained at the OFFICES of the Company, Waltham Abbey, ESSEX; at the PLACE OF SALE; of MR. J. CRAWTER, 41, BEDFORD ROW, W.C.; and of Messrs. CRAWTER, Land Agents and Auctioneers, Cheshunt, HERTS.

Now Ready, Handsome Cloth, 9s. Post free,

GAS MANUFACTURE

(THE CHEMISTRY OF);

A HANDBOOK ON THE PRODUCTION, PURIFICATION, AND TESTING OF ILLUMINATING GAS, AND THE ASSAY OF THE BYE-PRODUCTS OF GAS MANUFACTURE.

For the Use of Students.

By W. J. ATKINSON BUTTERFIELD, M.A., F.C.S.,

Head Chemist, Gas-Works, Beckton, London, E.

WITH NUMEROUS ILLUSTRATIONS.

*** This work deals with the MOST MODERN DEVELOPMENTS of the subject; and the chapter treating of the BYE-PRODUCTS will be found of special interest.

London: CHARLES GRIFFIN & Co., Ltd., Exeter Street, Strand.

PETTIGREW'S PATENT

Sulphate of Ammonia Plant

ON THE CONTINUOUS SYSTEM

Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.

Old Systems easily and cheaply converted.

ANY SIZE ERECTED COMPLETE AT HOME OR ABROAD.

Write for Particulars, Testimonials, and References to

GEO. PETTIGREW & Co.,

GAS AND CHEMICAL ENGINEERS,
MIDDLESBROUGH-ON-TEES.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

GAS AND WATER STOCKS AND SHARES IN THE

Wandsworth and Putney Gas Company.
Barnet District Gas and Water Company.
Hornsey Gas Company.
Tottenham and Edmonton Gaslight and Coke Company.
Croydon Commercial Gas Company.
Woking Water Company.
Peterborough Gas Company.
Dorking Gas Company.
Enfield Gas Company.
Uxbridge and Hillingdon Gas Consumers' Company.
Waltham Abbey and Cheshunt Gas and Coke Company.
South-West Suburban Water Company.
Kingston-on-Thames Gas Company.
Dartford Gas Company.
Great Yarmouth Gas Company.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, E.C., on Monday, April 20, 1896, at Two o'clock precisely, in lots.

Particulars, when ready, may be obtained at the MART, and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE HARROW AND STANMORE GAS COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, London, E.C., on Monday, April 27, at Two o'clock, in lots of Ten Shares each,

500 £10 "C" SHARES (fully paid)
IN THE
HARROW AND STANMORE GAS COMPANY,

ranking for a Standard Dividend of 7 per cent.; the last Dividend on the same class of Shares having been at the rate of 5¼ per cent. per annum, and offering an Investment of the soundest character.

Particulars of the SECRETARY of the Company at the Gas-Works, HARROW; and of the AUCTIONEER, 18, FINSBURY CIRCUS E.C.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

ARMSTRONG'S
PATENT
CANDLE SAFETY LAMPS.

Are a great improvement on Oil, giving a good Light, requiring little or no Cleaning, and when once lighted no further attention is necessary. The Candles are made to burn 5, 7, or 9 hours.

43, MANCHESTER STREET, GRAY'S INN ROAD, W.C.

COKE-BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.
And at STROUD, GLOUCESTERSHIRE.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

NOTICE.

Whereas it has come to the knowledge of the INCANDESCENT GAS-LIGHT COMPANY, Limited, of Palmer Street, Westminster, that a Company called the Meteor Incandescent Gas-Light Company, Limited, a firm known as Putz and Co., and a Company known as the Evening Sunlight Incandescent Light Company or the New Incandescent Light Company, are selling, and are offering for sale, forms of Incandescent Gas-Lights called respectively the "Meteor," the "Champion," and the "Evening Sunlight,"

THIS IS TO GIVE NOTICE, THAT THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, will commence ACTIONS FOR INFRINGEMENTS OF THEIR PATENTS against all persons found dealing in any manner with the said "Meteor," "Champion," or "Evening Sunlight" Incandescent Gas-Lights, which are all constructed in Infringement of the Patent of the Incandescent Gas-Light Company, Limited.

The validity of the Company's Patent has been certified by the Hon. Mr. Justice Romer.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WARNING.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WHEREAS, it has been brought to the notice of the INCANDESCENT GAS-LIGHT COMPANY, LIMITED, THAT DIVERS FIRMS UPON THE CONTINENT OF EUROPE are Manufacturing Incandescent Gas-Mantles, and are sending the same into this Country, and are advertising for Agents to push the sale of these Mantles,

THIS IS TO GIVE NOTICE, THAT ALL SUCH MANTLES ARE INFRINGEMENTS OF THE COMPANY'S PATENT, and that the Company will take proceedings for Infringement against all persons purchasing or using any of such Incandescent Gas-Mantles. THE COMPANY OWN THE MASTER PATENTS in this Country for the manufacture of Incandescent Gas-Mantles, and the validity of such Patents has already been certified by the Honourable Mr. Justice Romer, and the Company will enforce their Patent Rights against all Infringers.

FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.
11, Victoria Street, Westminster.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an Action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.
Nov. 30, 1895.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.
Telegrams: "HUNTER, PORT GLASGOW."
Established 1872.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

JUNKERS' CALORIMETER

SHOWS AT A GLANCE THE HEATING VALUE OF GAS.

NO BOMB. NO ANALYSIS.

See Illustrated Advertisement in the "JOURNAL" for March 24 (second page of Wrapper).

Reduced Price £15 15s.

HERMANN KÜHNE,
25-35, New Broad Street, London, E.C.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton .	10,500	Cubic Feet.
Illuminating Power .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
8 Lombard Street,
NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

ESTABLISHED 1862.

TRADE MARK.

NEW GAS PLANT CEMENT

For all Joints in connection with

SULPHATE PLANT. OIL-GAS PLANT. GAS. TAR. AMMONIA.

SAMPLES ON APPLICATION.

SPECIAL PAINTS FOR GAS-WORKS.

Telegrams "Enamel." Nat. Tel. 1759.

John E. Williams & Co., *Victoria Paint Works,* **Manchester.**

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

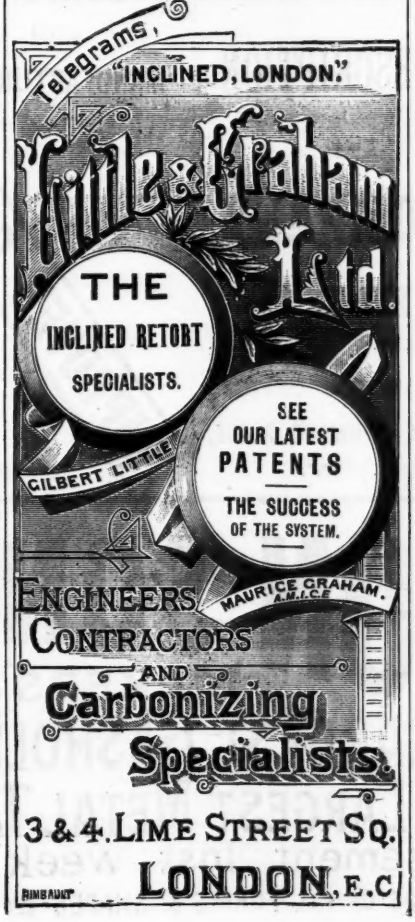
Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.



TAR AND LIQUOR PURCHASED.

JOHN CLARKSON MAJOR,
(Established 1851,)
Tar Distiller and Manufacturing Chemist,
WOLVERHAMPTON.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

LONDON OFFICE:
90, CANNON STREET, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
12, JOHN STREET, ADELPHI, LONDON, W.C

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

London Office: R. Cull, 31, Old Broad St., E.C.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, near DEWSBURY.

LOW MOOR BLACK BED
GAS COAL.
YIELD OF GAS PER TON - 10,375 CUBIC FEET.
ILLUMINATING POWER - 17·50 SPERM CANDLES.
COKE - - - - - - - - - 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.
A TRIAL IS RESPECTFULLY SOLICITED.

OXIDE OF IRON.
NATURAL BOG ORE FROM OWN MINES.
Samples and Prices on application.
Wm. H. MÜLLER & CO.,
81, PALMERSTON BUILDINGS, LONDON, E.C.
TRADE MARK: "Compascum." Telegraphic Address: "FERRUM."

THE THAMES BANK IRON CO.
UPPER GROUND STREET, LONDON, S.E.,
SUPPLY FROM STOCK
CAST-IRON RETORTS.
AND ALL KINDS OF GAS-WORKS APPARATUS.
SOCKET-PIPES FOR GAS OR WATER PURPOSES.
FLANGE PIPES FOR STEAM.
Sole Manufacturers of LYON'S 'PATENT' GAS MAIN SYPHONS.
Agents for
ATTERTON'S PATENT APPARATUS for CHARGING RETORTS.

GAS & WATER PIPES
AND
CASTINGS OF EVERY DESCRIPTION.
MANUFACTURED BY THE
CLAY CROSS COMPANY,
CHESTERFIELD.

TRADE MARK. CXC | TELEGRAMS: "JACKSON" CLAY CROSS. | LONDON OFFICE: 12, BURWOOD PLACE, W.

WILLIAM INGHAM & SONS,
Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS,
Near LEEDS,
Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

J. & W. HORTON
ETNA WORKS,
SMETHWICK,
NEAR BIRMINGHAM
(Established 50 Years),
PATENTEES
AND
MANUFACTURERS
OF
IMPROVED GASHOLDERS AND BOILERS
and Manufacturers of every description of
Gas Apparatus,
Cast and Wrought Iron Tanks, Purifiers, Condensers, Scrubbers, Retort-Lids, Cross-Bars and Screws, Wrought-Iron Boilers for Stationary, Portable, and Marine Engines, Sugar Pans, Coolers, Clarifiers, Punts, Boats, Bridges, Girders, Roofs, Cisterns, Oil-Tanks, Melting-Pots, Crucibles, Salt-Pans, Arch and Range Boilers, and every description of General Ironwork.
Drawings, Specifications, and Estimates supplied.

CLAYTON SON & Co., LTD,
MAKERS OF **LEEDS**
LARGEST GASHOLDER IN THE WORLD
ALSO THE **LARGEST METAL TANK**
See Advertisement last week, also next week
MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.

ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.

MAINTAINS A HIGH STANDARD IN RESIDUALS.

THE GRASSMOOR Co., LD., CHESTERFIELD.

W. E. SANDER,

COMMISSION AGENT, BERLIN, 41, FRIEDRICH STR.

SPECIALITIES: Incandescent Lamp Burners and Mantles (with or without electric lighting from any distance, by button from the wall, etc.).

INCANDESCENT SPIRIT LAMPS.

Electro-technical Ware of all kinds.

IMPORT and EXPORT.

BOWENS' Ltd. Successors,

STOURBRIDGE.

MANUFACTURERS OF

BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.

Established 1860.

The Climax of Regenerative Gas Lighting!!

THE

"VERTMARCHE"

A 280-CANDLE POWER

PLAIN IRON LAMP,

CLASS A— **55/-**

LIGHT for LIGHT less than half the price of any other Regenerative Lamp.

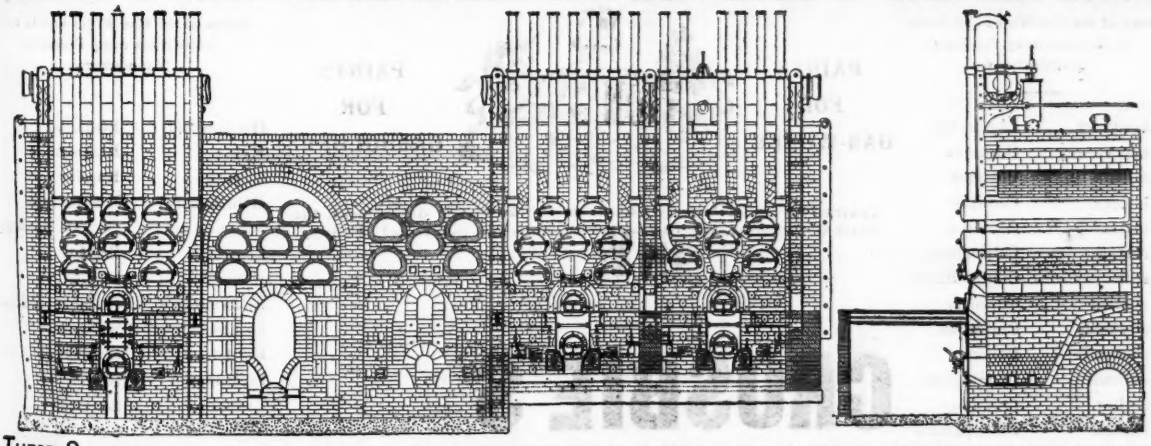
Manufactured in England.

HENRY GREENE & SONS,

153 & 155, CANNON STREET, LONDON BRIDGE, E.C.

PARTICULARS AND PRICES FREE. AGENTS WANTED.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.

Further Information and Pamphlets from Principal Agent.

JAMES MILNE & SON, LTD.,

GAS ENGINEERS,

MILTON HOUSE WORKS, EDINBURGH.

LONDON. — GLASGOW. — LEEDS.

ALDER AND MACKAY,

MANUFACTURERS OF

IMPROVED WET AND DRY GAS-METERS

IN CAST-IRON AND TIN CASES OF THE HIGHEST EXCELLENCE.

ORIGNAL MANUFACTURERS OF DRY METERS IN CAST-IRON CASES.

STATION METERS, EXPERIMENTAL METERS, PHOTOMETERS, & PRESSURE-GAUGES, &c

Results of Tests of Dry Gas-Meters (Section III.) of the Glasgow Philosophical Society's Gas Exhibition, as per London "Gas Journal," May 10, 1881.

	ALDER & MACKAY.	W. & B. Cowan.	G. Glover & Co.	James Keith.	D. B. Peebles & Co.
Total of Fast Tests .	47·2	6·9	33·6	62·3	53·7
Total of Slow Tests .	25·3	117·4	43·1	31·4	38·5
	72·5	124·3	76·7	93·7	92·2

Descriptive Circulars, Price Lists, and Full Particulars forwarded on application.

NEW GRANGE WORKS, EDINBURGH.

Some of the Gas-Works and Local Authorities using Crosbie's Manufactures.

Aberdovey
Abergavenny
Airedale
Aldridge
Antrim
Armagh
Ascot
Aylsham
Ballymena
Beaumaris
Bentham
Bewdley
Bideford
Birmingham
Blackburn
Bognor
Bollington
Boreham
Bramham
Brandon
Bridgnorth
Broadgreen
Broadstairs
Bromsgrove
Broughty Ferry
Builth
Burton
Buxton
Cannock
Carlow
Castleford
Chester le Street
Chesterton
Clitheroe
Cobham
Coleshill
Colombo
Collingham
Colney Hatch
Coventry
Cranbrook
Cullen
Deddington
Dewsbury
Downpatrick
Dursley
East Ardsley
Eastbourne
Elland
Ellesmere
Elstree
Eye
Farnham
Felixstowe
Garston
Gillingham
Gorey
Halesowen
Hanley
Hendon
Hinckley
Holywood
Honiton
Huelva

PAINTS FOR GAS-WORKS.

PAINTS FOR GASHOLDERS.

Contractors to Her Majesty's Government, the Indian Government, the Natal Government, the Turkish Government, the Netherlands Railway, the London County Council, &c., &c.

CROSBIE'S PAINTS.

Guaranteed genuine and free from adulteration, and specially made to withstand Gaseous Fumes.

Catalogue and Testimonials on Application.

ADOLPHE CROSBIE, LTD.,

COLOUR WORKS, WOLVERHAMPTON.

Some of the Gas-Works and Local Authorities using Crosbie's Manufactures.

Huntingdon
Hythe
Ilkeston
Irthlingboro'
Johannesburg
Kegworth
Kilrush
Kildwick
Kirkburton
Knutsford
Leamington
Ledbury
Leek
Leven, N.B.
Limerick
London
Loughborough
Lymington
Merthyr Tydfil
Milborne Port
North Middlesex
Outlane
Pembroke
Penmaenmawr
Portadown
Port Elizabeth
Portrush
Portsmouth
Pwllheli
Ramsey
Raunds
Richmond
Rochester
Rosscommon
Rugeley
Scarborough
Seaham Harbour
Seisdon
Shifnal
Shipston-on-Stour
Sidmouth
Skibbereen
Slough
Southam
Southend
Stafford
Stamford
Strood
Stroud
Swinton
Sudbury
Tetbury
Tokio
Uppingham
Uttoxeter
Ventnor
Warwick
Wexford
Wigston
Willenhall
Witney
Wollaston
Wolverhampton
Workington

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

MESSRS. HUMPHREYS & GLASGOW

Have constructed their EUROPEAN type of

CARBURETTED WATER-GAS PLANT

At the following Gas-Works:—

Copenhagen	700,000 Cub. Ft.	Liverpool	2,500,000 Cub. Ft.
Belfast	1,700,000 ,,	Tottenham	600,000 ,,
Glasgow	300,000 ,,	Brighton	1,250,000 ,,
Brussels	700,000 ,,	Bath	1,000,000 ,,
Santiago	400,000 ,,	New York	1,000,000 ,,
Swansea	700,000 ,,	Newburgh, N.Y.	350,000 ,,

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Manchester	3,000,000 Cub. Ft.
Preston	1,500,000 ,,	Brussels (Second Contract)	700,000 ,,
Southport	750,000 ,,	St. Joseph, Mo.	750,000 ,,
Tottenham (Second Contract)	750,000 ,,	Holyoke, Mass.	500,000 ,,

In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

9, Victoria Street, London, S.W. Telegrams: "EPISTOLARY, LONDON." *United States Office, 64, Broadway, New York.*

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

MIDLAND DISTRICT OFFICE: 22, TEMPLE ST., BIRMINGHAM—SOLE AGENT: A. C. SCRIVENER.
TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE No. 200.
LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.
TELEGRAPHIC ADDRESS: "PARKER LONDON."

Special Notice

TO GAS COMPANIES AND DISTRICT COUNCILS, ARCHITECTS, BUILDERS, AND CONTRACTORS.

The CHAMPION INCANDESCENT GAS-BURNER.

BEST LIGHT AT LOWEST COST.

We beg to advise our numerous friends and customers that the Champion Incandescent Gas-Burner still holds the field, and that our sales are increasing daily, notwithstanding the threats of our competitors.

Mantles are sold in any quantity without restriction for use of particular kinds, and are very durable.

F. J. PUTZ & CO.,

Temporary Premises: 16 & 17, GREAT ST. HELENS, LONDON, E.C.

Telegraphic Address: "PUTZ, LONDON."

Several large Show-Rooms will shortly be opened in different Districts. All Agents and Buyers are fully indemnified against Law Proceedings. A few more Agents wanted in several Districts.

PHILADELPHIA EXHIBITION, 1876.

ALSO SILVER MEDAL, PARIS.

The Highest Award for Gas-Retorts and other Goods in Fire-Clay has been awarded to KING BROTHERS for their Goods made from their renowned Stourbridge Fire-Clay.

KING BROTHERS,

Proprietors of

STOURBRIDGE CLAYS,

Manufacturers of

Fire-Bricks, Tank Blocks, Glass-House Bricks and Pots, Gas-Retorts, Crucibles in Clay and Plumbago, Gas-Oven Bricks, Bricks for Regenerator Furnaces and Hot-Air Stoves.

STOURBRIDGE, ENGLAND.

CRUCIBLE MANUFACTORY, 46, PENN STREET, CURZON STREET, BIRMINGHAM.

N.B.—Gas, Blast-Furnace, and Glass-House Bricks and Glass-House Pots always in Stock, or made on the Shortest Notice.

GASEOUS FIRING A SPECIALTY.

Telegraphic Address: "DRAKESON, HALIFAX."

GAS ENGINEERS.
RETORT SETTERS.
IRONFOUNDERS.

SOLE MAKERS OF-

"MITTON'S" PATENT SELF -SEALING- RETORT-LID.

JOMS DRAKE & SON

-SOLE AGENTS- For "HISLOP'S" PATENT REGENERATIVE — FURNACES. — FOR ENGLAND, WALES & ABROAD.

OVENDEN, HALIFAX.

LONDON OFFICE; 60. QUEEN VICTORIA ST., E.C.

Telephone No. 43. HALIFAX EXCHANGE.

CONTRACTORS.
FURNACE BUILDERS.
&c. &c.

- SOLE MAKERS OF -

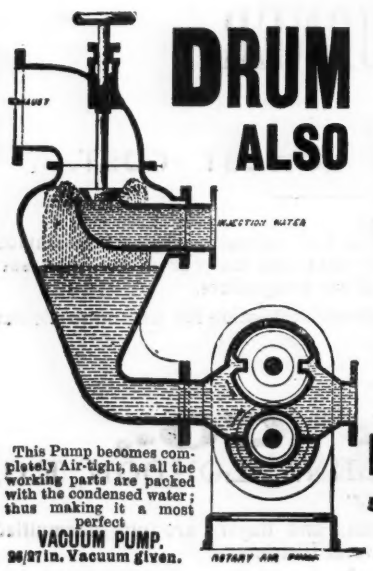
"SETTLE'S" PATENT COMBINED SEAL-REGULATING FLUSH-VALVE.

"The Force of the Piston Pump with the Capacity of the Centrifugal combined."

JOHNSON'S PATENT

DRUM PUMP AND EXHAUSTER

ALSO VACUUM PUMP AND CONDENSER.

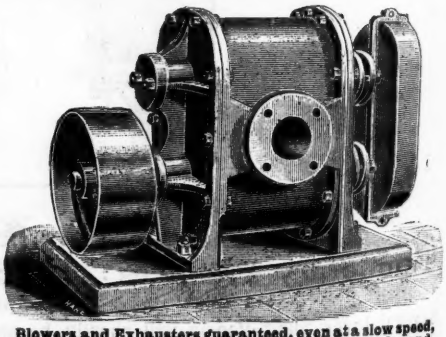


This Pump becomes completely Air-tight, as all the working parts are packed with the condensed water; thus making it a most perfect VACUUM PUMP. 26/27 in. Vacuum given.

No Priming, Valves, or Frictional Working Parts.

The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

DRUM ENGINEERING Co.
55, ATHOL ROAD,
BRADFORD.



Blowers and Exhausters guaranteed, even at a slow speed, to give a working pressure of 3 lbs. and upwards, and this without losing power by creating frictional Heat.

Patentee:
Mr. CHAS. HUNT,
Corporation Gas-Works,
Windsor Street,
BIRMINGHAM.

Sole Makers:
Messrs. S. CUTLER & SONS,
Providence Works,
Millwall,
LONDON.

THE

"CHARLES HUNT"

PATENT WASHER

IS IN EVERY RESPECT THE BEST APPARATUS OF ITS KIND, PERFORMING THE DUTIES OF BOTH WASHER AND SCRUBBER.

ALL TAR AND AMMONIA REMOVED.

CO_2 AND H_2S CONSIDERABLY REDUCED.

AUTOMATIC IN ACTION.

SIMPLE AND EFFICIENT.

ECONOMICAL.

SELECTED TESTIMONIALS.

The MANAGER of the RUGBY GAS-WORKS writes:—

"I have pleasure in stating that the apparatus has given me the greatest satisfaction, and continues to do the work required of it most admirably. Since its erection, it has effectually stopped the slightest trace of tar from passing beyond the lower chambers (although our Condensers are inefficient), and has completely purified the gas from ammonia, so far as the litmus test reveals it."

The MANAGER of the STROUD GAS-WORKS writes:—

"The Washer-Scrubber erected by you here is doing its work admirably, and every day proves its value. I like it immensely; and it exceeds my expectations, for there are no traces of ammonia in the gas after it has passed through; and it is furthermore unquestionably an excellent tar-extractor. I may add that the fact of there being no machinery to get out of order or require attention is a great advantage."

Mr. J. F. BELL, the Engineer of the STAFFORD CORPORATION GAS-WORKS, writes in respect to "C. Hunt" Washers put down at two Gas-Works under his superintendence:—

"I fully believe it to be the best washer invented, and hope to put it in at other works."

R. & A. MAIN,

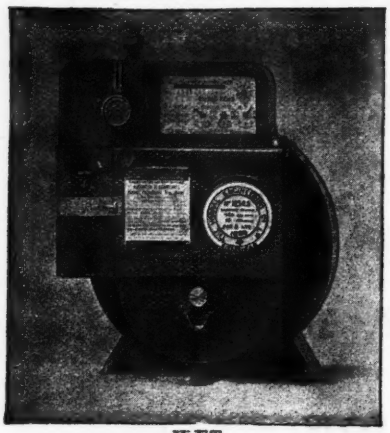
GAS COOKING AND HEATING STOVES,

92, ALDERSGATE STREET, KINNING PARK,

LONDON, E.C., & GLASGOW.

THE WIRRAL ENGINEERING COMPANY, LTD.

Patent New Prepayment Meters.

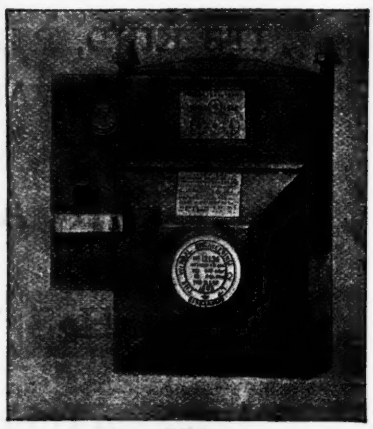


WET.

THE "PERFECT" AUTOMATIC.

Simple! Positive!! Accurate!!!

The only Prepayment Meter with no Springs, Counter-Balance Weights, or Frictional Gearing to get out of order.



DRY.

Particulars on Application to the COMPANY, 76, Hamilton Street, BIRKENHEAD.

THE HORSELEY CO., LTD., TIPTON, STAFFORDSHIRE.

MAKERS OF

GASHOLDERS & GAS PLANT,

PURIFIERS, SCRUBBERS, CONDENSERS, WASHERS, TANKS, VALVES, PIPES, LAMP PILLARS, RETORT-FITTINGS, ETC.

ALSO ALL KINDS OF

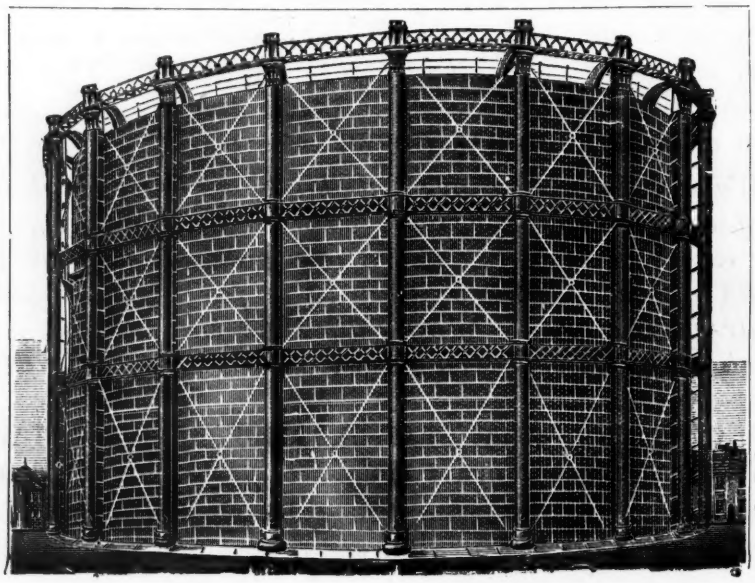
STRUCTURAL IRON

AND STEEL WORK.

BRIDGES,

ROOFS

PIERS, ETC.



WORKS AND HEAD OFFICE:
TIPTON,
STAFFORDSHIRE.

LONDON OFFICE:
11, VICTORIA ST.,
WESTMINSTER.

TELEGRAPHIC ADDRESSES:
"HORSELEY, TIPTON."
"GALILEO, LONDON."

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF

BEST FIRE-BRICKS, GAS-RETORTS,

LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.

Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND.

ESTABLISHED 1826.

JOSEPH CLIFF & SONS,

INCORPORATED IN

THE LEEDS FIRE-CLAY COMPANY, Ltd.,

WORTLEY, LEEDS.

LONDON OFFICES & DEPÔTS:

Baltic Wharf, Waterloo Bridge.

WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

LIVERPOOL:

16, Lightbody Street.

LEEDS:

Queen Street.

MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

GODDARD, MASSEY, & WARNER'S

IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO

GODDARD, MASSEY, & WARNER,
ENGINEERS,
NOTTINGHAM.

The Apparatus has been supplied to the following Firms—

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (FOUR APPARATUS).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
HUDDERSFIELD.	ORMSKIRK.	LUTON.
		HAMPTON COURT.

PELOUZE & AUDOUIN'S

PATENT MECHANICAL CONDENSER.

Over 292,000,000 Cubic Feet of Gas per Day is passing through about 550 of these Machines.

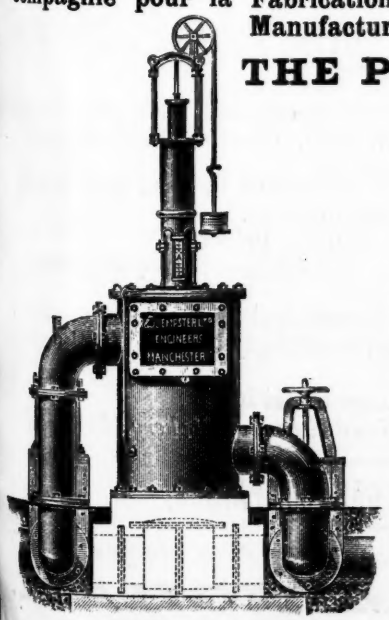
Messrs. R. & J. DEMPSTER, Limited,

HAVE PLEASURE IN ANNOUNCING THAT THEY HAVE MADE ARRANGEMENTS WITH THE

Compagnie pour la Fabrication des Compteurs et Materiel d'Usines a Gaz, of Paris, to Manufacture and Sell in this Country and the Colonies,

THE PELOUZE & AUDOUIN CONDENSER,

According to P. AUDOUIN'S LATEST PATENTS.



FRONT ELEVATION.

This Apparatus is in very general use in most of the Gas-Works on the Continent and in America; over **550** being in use in different parts of the World for condensing and arresting all Tar Particles and Vapours from the Gases from Coal, Oil, and Wood.

The large number in use is sufficient proof of its utility. By the almost complete elimination of Tar, which is effected to the extent of 99·7 per cent., it facilitates Purification in the Purifiers, by preventing the clogging or obstruction of the Purifying Materials, which, in consequence, last much longer; thus effecting a Saving both in Materials and Labour.

So effective is this Apparatus that a piece of white paper placed over a Test-Tap on the Inlet of the Machine is immediately covered with Tar, whilst on the Outlet the white paper remains perfectly clean.

The Machines are made in the following sizes, for Works producing per 24 hours—

	Cubic Feet.		Cubic Feet.
0	35,000	5	500,000
1	70,000	6	700,000
2	140,000	7	1,240,000
3	210,000	8	1,750,000
4	350,000	For larger Makes, two Machines are recommended.	

For Prices and further Particulars, apply to the Sole Makers—

Telegraphic Address: "KRUBBER, MANCHESTER." **R. & J. Dempster, Ld., Gas Plant Works, Newton Heath, Manchester.** Nat. Telephone Nos. 2296 & 54.

THE "PARKINSON"

GOLD MEDAL

GAS COOKER.

SPECIAL FEATURES.

May now be had with either Cast or Wrought Iron Enamelled Linings, very easily cleaned, and practically indestructible. The "Parkinson" Cooker is now fitted with the registered Cast-Iron Hinged Gate—an invaluable contrivance for ensuring a clean, well-ventilated Oven.

WHAT GAS ENGINEERS SAY:—

"I have no sort of hesitation in testifying to the excellence and effectiveness of the Gas Cookers. Give no trouble, bake admirably, and cook to perfection."

JOHN L. COCKER, *Merthyr Tydvil Gas Company.*

"They are giving our customers universal satisfaction."

B. W. SMITH, *Smethwick Gas-Works.*

WHAT COOKERY TEACHERS SAY:—

"The teachers express themselves as thoroughly pleased with them, and have put them to very considerable tests."

R. P. WARD, *Cheshire County Council.*

"During last winter we used them at all the centres where we cooked by gas; and we shall continue to do so until we find they are superseded, which I consider unlikely."

MATILDA LEES DODS, Principal,
Birmingham and Midland School of Cookery.

"It is easy to manage, very good in its results, and most economical in the consumption of gas. Pastry, bread, cakes, and meat are all equally well cooked and beautifully browned in the oven. The grilling, boiling, and simmering arrangements are perfect."

I am, Gentlemen, yours faithfully,
(Signed) SOPHIE THWAITES, *International School of Cookery, Liverpool.*

Adopted by many LONDON AND PROVINCIAL GAS COMPANIES.

COTTAGE LANE WORKS, CITY ROAD,
LONDON.
Telegraphic Address: "INDEX."

BELL BARN ROAD WORKS,
BIRMINGHAM.
Telegraphic Address: "GAS-METERS."

[See also Advt. p. 738.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, April 7, 1896.